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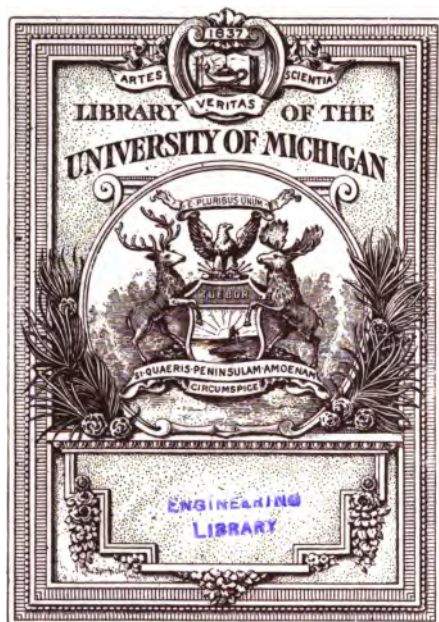
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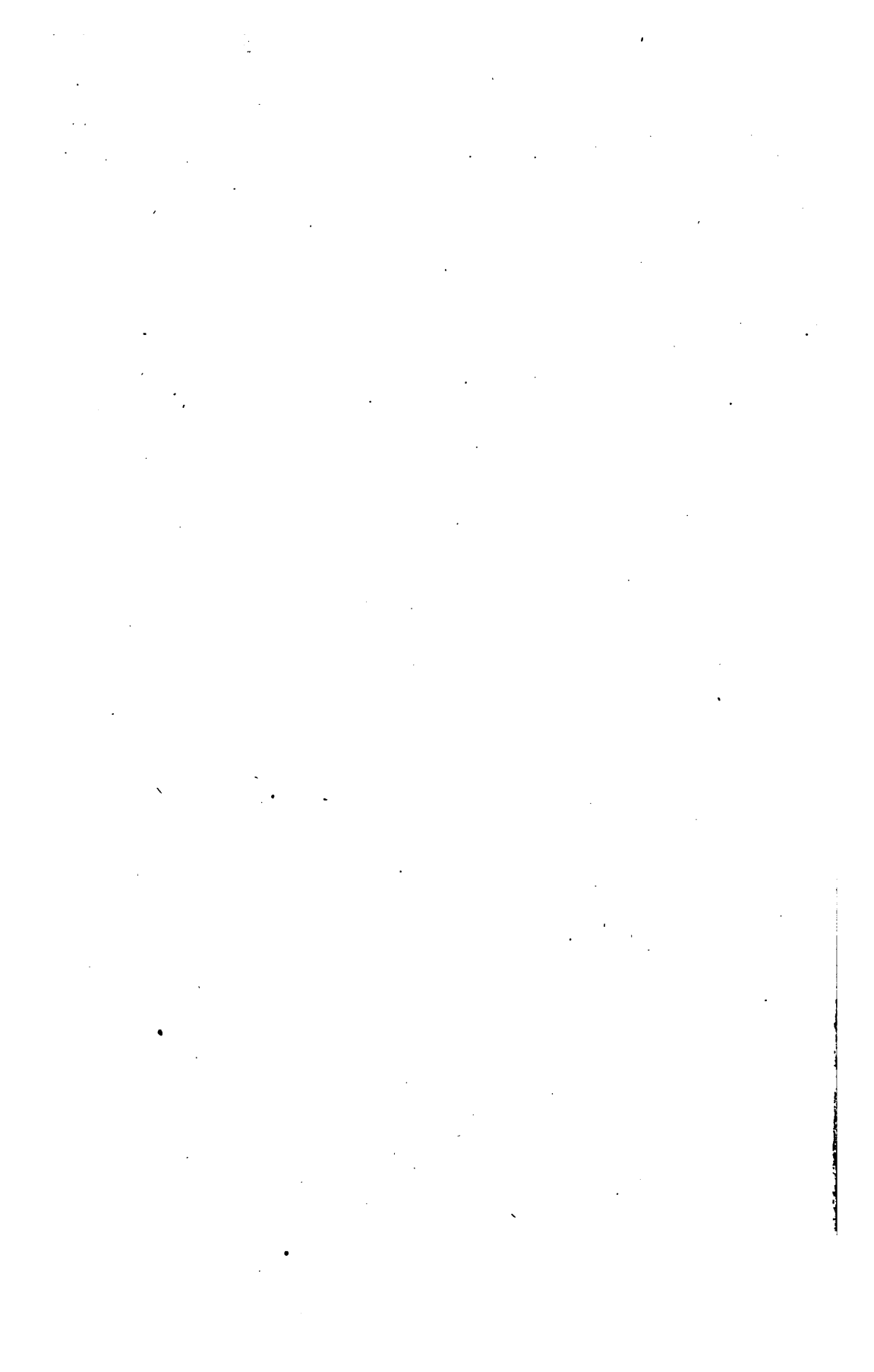
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ANNUAL REPORT

OF THE

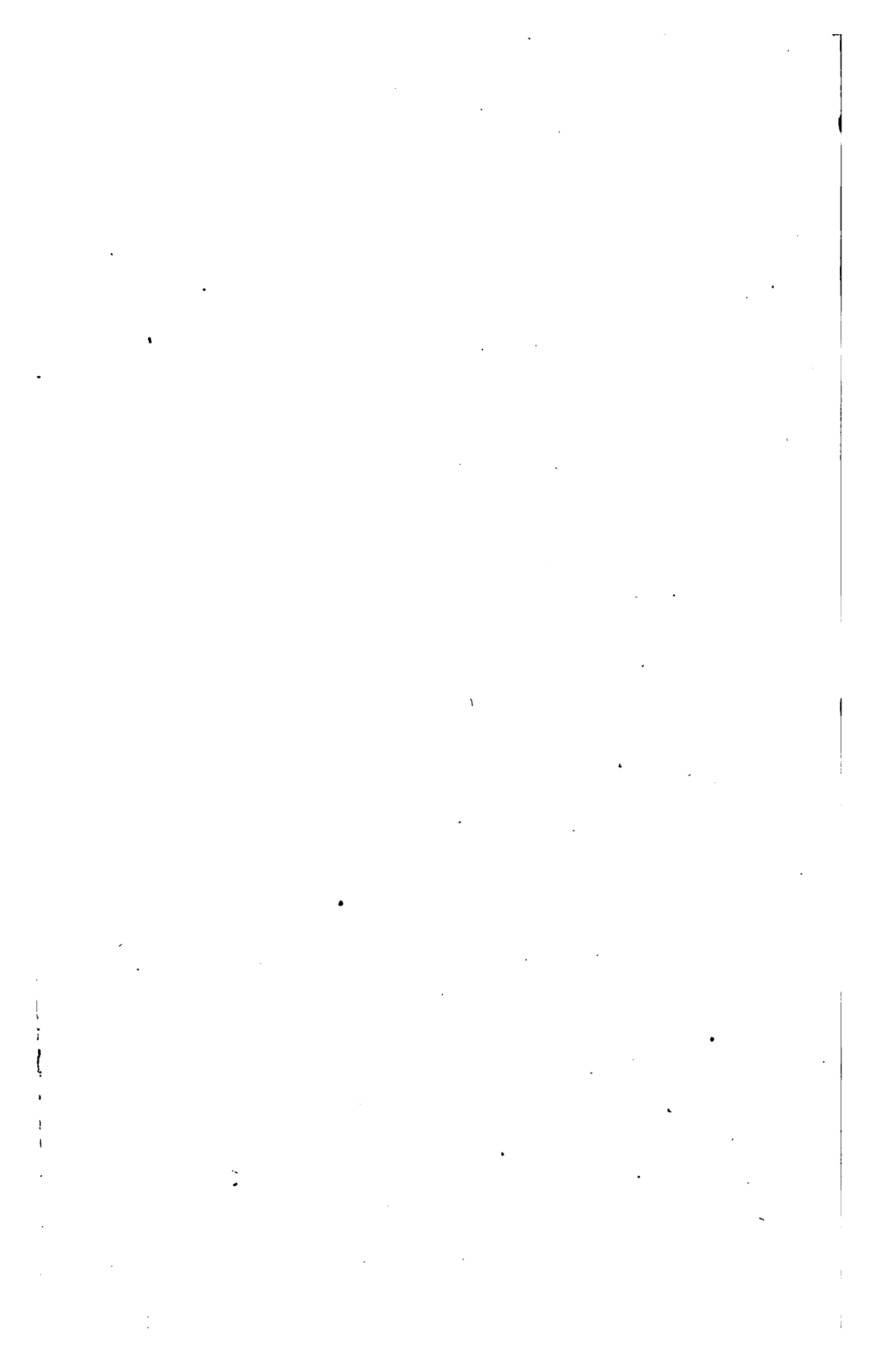
State Engineer and Surveyor

ON THE

CANALS OF THE STATE.

PRESENTED TO THE LEGISLATURE JANUARY 3, 1872.

ALBANY:
THE ARGUS COMPANY, PRINTERS.
1872.



STATE OF NEW YORK.

No. 11.

IN ASSEMBLY,

January 3, 1872.

ANNUAL REPORT OF THE STATE ENGINEER AND SURVEYOR ON THE CANALS OF THE STATE.

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, *January 3, 1872.*

HON. HENRY SMITH,

Speaker of the Assembly :

SIR.—I have the honor herewith to transmit to the Legislature the annual report of my predecessor, on the canals of the State, for the year ending September 30th, 1871.

Yours, respectfully,

WM. B. TAYLOR,

State Engineer and Surveyor.

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, *January 1, 1872.*

HON. WILLIAM B. TAYLOR,

State Engineer and Surveyor :

SIR.—I herewith inclose the annual report of the State Engineer and Surveyor, on the canals of the State, for the year ending September 30, 1871.

Yours, respectfully,

VAN R. RICHMOND.

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REPORT.

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, *January 1, 1872.* }

To the Honorable the Legislature of the State of New York :

The State Engineer and Surveyor, in obedience to the requirements of act, chap. 777, Laws of 1850, has the honor to submit herewith his annual report for the fiscal year ending September 30, 1871.

ENGINEER DEPARTMENT.

Act, chap. 477, Laws of 1865, authorizes the appointment, by the Canal Board, of three Division and three Resident Engineers ; and act, chap. 794, Laws of 1866, authorizes the appointment of an additional Resident Engineer in charge of the Chenango canal extension. The existing laws, therefore, only recognizes seven official engineers.

The subordinate engineers are employed by the Division Engineers, with the assent of the State Engineer and Surveyor and the Canal Commissioner in charge of the division on which they are so employed.

The offices of the Division and Resident Engineers are located as follows :

At Albany, for the Eastern Division.

At Syracuse, for the Middle Division.

At Rochester, for the Western Division.

At Owego, for the Chenango canal extension.

The expenditures, on account of the Engineer Department for the year ending September 30, 1871, are as follows :

Eastern Division.....	\$49,952 32
Middle Division.....	35,567 30
Chenango canal extension.....	13,118 03
Western Division.....	31,867 66
Total.....	<u>\$130,505 31</u>

The following shows the amount of work done under the supervision of the Engineer Department during the fiscal year:

Eastern Division.....	\$686,750 81
Middle Division.....	627,523 19
Chenango canal extension.....	105,638 92
Western Division.....	427,168 13
Total	<u>\$1,847,081 05</u>

The cost of engineering has been about seven per cent of the cost of the work done.

CANALS.

The State canals, for convenience in construction and the superintendence of repairs, are divided into three divisions, Eastern, Middle, and Western; each under the charge and supervision of a Canal Commissioner, a Division and Resident Engineer.

EASTERN DIVISION.

Names of canals.	Miles.
Erie canal from Albany to east bank of Oneida Lake canal, Albany basin (called one mile for tolls by chapter 200, Laws of 1849).....	133.58
Port Schuyler and West Troy side cut.....	.77
Pond above Troy dam.....	.35
Champlain canal and Waterford side cut.....	3.00
Glen's Falls feeder and pond above.....	66.00
Black River canal.....	12.00
Black River feeder and pond above dam.....	35.33
Delta feeder	12.09
Black River improvement.....	1.38
	42.50
Total miles.....	<u>307.00</u>

This division has been in charge of E. H. Crocker, Division Engineer, and Peter Hogan, Resident Engineer.

MIDDLE DIVISION.

Names of canals.	Miles.
Erie canal from east side of Oneida Lake canal to east line of Wayne county.....	68.58
Navigable feeders to Erie canal:	
Limestone .....	.80
Butternut.....	1.55
Camillus.....	1.00
	<hr/> 3.35
Oneida Lake canal.....	7.00
Oswego canal	38.00
Cayuga and Seneca canal.....	22.77
Crooked Lake canal.....	8.00
Chemung canal and feeder.....	39.00
Chenango canal.....	97.00
Oneida river improvement	20.00
Seneca river towing-path	5.75
Baldwinsville canal and improvement to Jack's Reef.....	12.50
Cayuga inlet.....	2.00
	<hr/>
Total miles.....	323.95
	<hr/> <hr/>

This division has been in charge of M. S. Kimball, Division Engineer, and Howard Soule, Jr., Resident Engineer. The Chenango canal extension has been in charge of Charles L. McAlpine, Resident Engineer.

WESTERN DIVISION.

Names of canals.	Miles.
Erie canal from east line of Wayne county to Buffalo.....	148.50
Genesee Valley canal from Rochester to Millgrove.....	113.50
Dansville branch of Genesee Valley canal.....	11.00
Genesee feeder at Rochester.....	2.25
Genesee feeder at Oramel.....	.75
	<hr/>
Total miles.....	276.00
	<hr/> <hr/>

This division has been in charge of Daniel Richmond, Division Engineer, and J. Nelson Tubbs, Resident Engineer.

From the above statements, it will be seen that there are 906.95 miles of navigable canals and feeders, and there are also 5.68 miles of unnavigable feeders, making a total of 912.63 miles of canals and feeders under the supervision of this department, exclusive of the Chenango canal extension, in process of construction.

The total length of navigable canals and feeders, with rivers and lakes connected artificially therewith, in the State of New York:

	Miles.
Total length of artificial canals and feeders.....	906.95
Length of Hudson river, New York to Waterford.....	155.00
Lake Champlain, Whitehall to Rouse's Point.....	111.00
Oneida lake.....	22.00
Cayuga lake.....	39.00
Seneca lake.....	35.00
Crooked lake.....	19.00
Delaware and Hudson canal (in this State).....	87.00
Junction canal.....	18.00
Total	<u>1,392.95</u>

Dimensions and Capacity of the New York State Canals.

NAME OF CANAL.	When authorized.	When completed.	Length in miles.	SIZE OF CANAL.			NUMBER AND SIZE OF LOCKS.				Average burden boats.	Maximum burden of boats.
				Width on surface.	Width on bottom.	Depth of water.	Number of locks.	Length between quoins.	Width in clear.			
Erie canal (original)	1817	1825	363	40	28	4	83	90	15	70	76	
Erie canal, enlargement same	1835	1862	350½	70	56	7	72	110	18	210	240	
Oswego canal (original)	1825	1828	38	40	24	4	18	90	15	70	76	
Oswego canal, enlargement same	1847	1862	38	70	56	7	18	110	18	210	240	
Cayuga and Seneca canal (original)	1825	1828	21	40	24	4	10	90	15	70	76	
Cayuga and Seneca canal, enlargement same	1836	1862	23	70	56	7	11	110	18	210	240	
Champlain canal	1817	1822	66	50	35	5	20	100	18	80	85	
Champlain canal (Glen's Falls feeder)	1822	1837	12	50	35	5	12	100	18	80	85	
Champlain canal (pond above Troy dam)	1837	1837	3	42	26	4	1	90	15	70	76	
Black River canal and feeder	1836	1849	50	42	26	4	109	110	18	70	76	
Black River canal improvement	1849	1861	42	42	26	4	112	90	15	70	76	
Genesee Valley canal	1836	1861	124½	42	26	4	116	90	15	71	76	
Chemung canal	1833	1836	97	40	24	4	53	90	15	85	90	
Chemung canal and feeder	1839	1831	39	42	26	4½	2	130	30	70	76	
Oneida River improvement	1839	1839	20	80	60	4½	7	90	15	70	76	
Oneida Lake canal	1832	1839	7	40	24	4	1	90	15	70	76	
Baldwinsville canal and Seneca towing-path	1838	1839	5½	40	24	4	1	90	15	70	76	
Crooked Lake canal	1838	1833	8	42	26	4	27	90	15	70	76	

Feeders.

The following embraces all the available feeders for supplying the Erie canal with water during the dry season, with approximate cost of each :

NAME OF FEEDER.	When brought into use.	Source of supply.	Miles entering the canal from Albany.	Supply cubic feet per minute.	Total cost of feeder.
Mohawk river at Cohoes .....	.....	Champlain canal .....	.....	6,570	.....
Roxford Flats feeder	1844	Mohawk river	26	10,979	\$25,000 00
Schoharie Creek feeder	1845	Creek	51	6,800	30,000 00
Rocky Rift feeder	1856	Mohawk river	78	10,402	190,000 00
Little Falls feeder	1843	Mohawk river	87	12,643	12,500 00
Ilion Creek feeder	1838	Creek	98	800	1,000 00
Chenango canal	1836	Through lock	110	911	.....
Butts' creek	1838	Creek	124	1,400	530 00
Mohawk feeder at Rome	1858	Mohawk river	125	11,766	25,976 36
Black River canal at Rome .....	.....	Through lock	125	1,294	.....
Oneida Creek feeder	1835	Creek	140	1,500	84,498 00
Cowasselon Creek feeder	1858	Creek	143	320	10,089 65
Erieville reservoir	1850	Reservoir .....	.....	2,130	26,837 03
Chittenango Creek feeder	1840	Creek and outlet	152	250	7,555 33
Cazenovia Lake reservoir	1867	Reservoir .....	.....	2,631	10,884 73
De Ruyter reservoir, through	1863	Reservoir .....	.....	3,972	158,378 20
Limestone creek	1852	Creek and outlet	158	210	14,871 30
Orville (Butternut creek) feeder	1858	Creek	161	450	45,000 00
Camillus feeder	1843	Creek	175	1,500	11,327 68
Skaneateles Lake reservoir	1844	Reservoir	185	7,520	14,927 55
Genesee River feeder	1826	Genesee river	259	350	42,750 54
Genesee Valley canal	1842	Through lock	259	861	.....
Oak Orchard Creek feeder	1840	Creek	303	1,400	29,722 42
Lake Erie, Buffalo	1856	Lake	350½	35,000	.....
				121,867	.....
Total cost enlargement feeders					\$701,848 79
Total cost original Erie canal feeders					101,147 00

Locks.

NAME OF CANAL.	Length in miles of canals.	Number of locks.	Feet of lockage.	Feet lockage per mile.
Erie canal (57 double, 15 single)	351.78	72	654.80	1.86
Navigable feeders of same	3.35	.....	.....	.....
Champlain canal	66.00	33	179.50	2.72
Pond above Troy dam	3.00	.....	.....	.....
Glen's Falls feeder and pond	12.00	.....	132.00	11.00
Black River canal	35.33	109	1,082.25	30.63
Black River feeders	13.47	.....	.....	.....
Black River improvement	42.50	1	.....	.....
Oneida Lake canal	6.00	7	62.00	10.33
Oswego canal	38.00	18	154.85	4.07
Oneida River improvement	20.00	2	7.85	0.39
Seneca River towing-path	5.00	.....	.....	.....
Baldwinsville canal	1.00	1	8.00	8.00
Cayuga and Seneca canal	22.77	11	76.61	3.36
Crooked Lake canal	8.00	27	277.83	34.73
Chemung canal and feeder	39.00	53	504.88	12.95
Cayuga inlet	2.00	1	.....	.....
Chenango canal	97.00	116	1,015.33	10.46
Genesee Valley canal and feeder	116.50	114	1,045.39	8.96
Dansville branch	11.00	.....	82.50	7.50
893.70		565	5,283.79	5.09

NUMBER, extent and approximate cost of structures upon the Erie canal at completion of enlargement in 1862.

Quantities.	KIND OF STRUCTURES.	Price.	Amount.
497,869..	Square feet flooring in 158 iron bridges.....	81	\$354,678 89
516,259..	Square feet flooring in 383 wooden bridges.....	38	196,178 42
540 sets..	Bridge abutments	\$2,750 00	1,485,000 00
540 sets..	Bridge embankments, etc.	1,800 00	972,000 00
57 sets..	Double locks, aggregate length 9,833 feet.....	73,850 00	4,209,450 00
13 single..	Locks, aggregate length 2,415 feet	31,590 00	441,840 00
2 single..	Guard locks, aggregate length 345 feet.....	23,000 00	46,000 00
5 single..	Weigh-locks, aggregate length 737 feet.....	47,036 00	235,180 00
24,235..	Lineal feet of trunk in 32 aqueducts	310 00	7,512,850 00
2,393..	Lineal feet of waste walls, waste-weirs.....	42 00	99,246 00
11..	Stop gates.....	2,000 00	22,000 00
190..	Stone arch culverts, aggregate spans 1,523	4,000 00	760,000 00
94..	Composite culverts, aggregate spans 435	1,700 00	150,800 00
Total approximate cost of structures.....			\$16,494,218 31

STATEMENT showing the total cost of construction of the New York State canals, together with the cost of repairs, maintenance and collection ; also the total amount of tolls received from each. (Each canal is credited with the amount of tolls upon the tonnage contributed to the Erie, and charged with its proportion of repairs and maintenance upon the same, up to and including 1866.)

NAME OF CANAL.	EXPENDITURES.			RECEIPTS.
	For construction, enlargements and improvem'ts.	For repairs, maintenance and collection.	Total for construction, management, etc.	From tolls.
Erie and Champlain	\$46,018,234	\$12,900,333	\$58,918,567	\$81,057,168
Oswego.....	3,490,949	4,639,219	8,130,168	9,283,220
Cayuga and Seneca.....	1,520,542	1,200,044	2,720,586	2,184,300
Chemung.....	1,273,261	1,794,649	3,067,910	2,012,575
Crook'd Lake.....	333,287	459,374	792,661	520,416
Chenango.....	2,782,124	1,022,026	3,804,150	737,285
Black River.....	3,224,779	498,866	3,723,645	242,608
Genesee Valley.....	5,827,813	1,689,303	7,517,116	1,306,913
Oneida Lake.....	64,837	123,294	188,071	65,180
Baldwinsville.....	23,556	25,035	48,591	1,261
Oneida River improvement.....	146,944	25,005	171,999	204,288
Seneca River towing-path.....	1,488	20	1,508	5,251
Cayuga inlet.....	2,968	.....	2,968	4,596
Totals	\$64,710,832	\$24,377,108	\$89,087,940	\$97,625,066

Total cost of construction, as above..... \$64,710,832
 Total interest on same..... 93,736,654
 Total cost maintenance, repairs and collection 24,377,114
 Total interest on same..... 27,268,895

Total from commencement to completion..... \$210,093,495
 Aggregate receipts from tolls, with interest thereon 202,619,510

Present cost to the State of the entire canal system, \$7,473,985

The number and tonnage capacity of the boats built and registered in each year since 1857 has been as follows:

YEAR.	Boats.	Tons.	Average of boats.
1857.....	329	37,510	114
1858.....	255	27,830	109
1859.....	206	20,150	98
1860.....	403	48,355	120
1861.....	619	95,230	154
1862.....	850	142,470	168
1863.....	771	119,170	177
1864.....	399	56,235	141
1865.....	200	28,795	144
1866.....	485	74,630	154
1867.....	530	80,380	155
1868.....	387	64,470	167
1869.....	298	46,640	157
1870.....	262	43,400	157
Total.....	5,991	884,245	.....

COMPARATIVE statement of the total tonnage movement over the New York State canals, New York Central Railroad and Erie Railway, together with the receipts per ton per mile on each from 1860 to 1870 inclusive.

YEAR.	NEW YORK STATE CANALS.		NEW YORK CENTRAL RAILROAD.		ERIE RAILWAY.	
	Tons moved one mile.	Receipts per ton per mile.	Tons moved one mile.	Receipts per ton per mile.	Tons moved one mile.	Receipts per ton per mile.
1860.....	809,524,596	cts. 0.994	199,231,392	2.06	214,094,395	cts. 1.84
1861.....	863,623,507	1.080	237,392,974	1.96	251,350,127	1.73
1862.....	1,123,548,430	0.959	296,963,492	2.22	351,092,265	1.89
1863.....	1,034,130,023	0.876	312,195,796	2.40	403,670,861	2.09
1864.....	871,335,150	1.150	314,061,410	2.75	422,013,644	2.31
1865.....	843,915,779	1.100	264,993,626	3.31	388,557,213	2.76
1866.....	1,012,448,034	1.000	331,075,547	2.92	478,485,772	2.45
1867.....	958,362,953	0.900	362,180,606	2.53	549,888,422	2.04
1868.....	1,033,751,268	0.880	366,199,786	2.59	595,699,225	1.92
1869.....	919,153,611	0.920	474,419,726	2.30	817,829,190	1.60
1870.....	904,351,572	0.83	* 769,087,777	1.86	898,862,718	1.37
Total.....	10,374,144,995	.....	3,927,822,132	.....	5,518,660,891	.....

For the ten years previous to 1870, the canals carried about twenty-four per cent more freight than the New York Central and Erie railroads together.

The following shows the length and the cost of construction and equipment of these three great trunk lines, from the reports of 1870, viz.:

* Includes Hudson River railroad, 150 miles.

	Cost.	Miles.
New York State canals	\$80,710,832	900
N. Y. Central and Hudson River railroads,	59,765,684	740
Erie railway.....	73,945,587	823
Totals.....	<u>\$214,422,103</u>	<u>2,463</u>

The average yearly business upon the canals for nine years following 1860 is nineteen per cent greater than the business for that year, while upon the railroads of the State the increase has been for the same period eighty-nine per cent greater than the business of 1860.

The total number of tons moved one mile on all the canals and railroads in the State, in the ten years from 1860 to 1869 inclusive, was 19,662,593,782; of this amount the canals, with an average season of less than seven and one-half months in each year, transported $48\frac{2}{10}$ per cent, or very nearly one-half; and all the railroads, in operation the whole time, transported $51\frac{8}{10}$ per cent. In several of these years the canals transported more freight in the seven and one-half months than all the railroads in the State did in the whole twelve months.

In 1860 there were 3,146 miles of railroads in operation in this State, and in 1870 there were 4,773 miles; an increase of 1,627 miles.

ANNUAL STATEMENT, showing the total amount of construction work performed during the fiscal year ending September 30th, 1871; also the amount of work remaining to be done on same upon the New York State canals, under the supervision of the Engineer Department upon ordinary and extraordinary repairs.

NAME OF CANAL.	Amount done during fiscal year.	Amount remaining to be done.
WORK UNDER CONTRACT:		
Erie	\$587,671 03	\$580,253 50
Champlain.....	266,012 23	116,554 50
Black River.....	18,861 45	2,508 00
Oswego.....	153,891 13	130,094 00
Chenango.....	120,074 42	7,948 50
Chemung.....	31,638 25	14,474 20
Cayuga and Seneca.....	26,821 68	14,889 10
Crooked Lake.....	5,478 91	1,691 00
Genesee Valley.....	68,198 27	29,780 00
Total	\$1,278,637 37	\$898,186 80
SPECIAL IMPROVEMENTS AND EXTENSION:		
Champlain improvement, Laws 1864.....	\$53,368 81	.....
Enlargement Oneida Lake canal.....	21,280 00	\$63,960 00
Chenango canal extension.....	105,638 92	508,202 94
Doubling locks on Western Division.....	122,620 00	311,340 00
Total work under contract	\$1,581,544 60	\$1,776,789 74
WORK DONE BY CANAL COMMISSIONERS:		
Erie canal.....	\$78,041 41	\$1,014 00
Champlain.....	26,887 74	.....
Black River.....	24,868 41	.....
Oswego.....	3,917 00	.....
Chenango.....	1,580 41	.....
Chemung.....	67,776 76	.....
Crooked Lake.....	62,464 72	.....
Sum total.....	\$1,847,081 05	\$1,777,808 74

WORK AUTHORIZED, NOT UNDER CONTRACT.

The following is the estimated cost, at engineer's prices, of authorized work not under contract:

Chenango canal extension.....	\$368,773 00
Construction Fish creek feeder.....	693,250 00
Total.....	<u>\$1,062,023 00</u>

For details of the work done during the past season upon construction, and for recommendations for the coming season, for which appropriations are needed, reference should be had to the reports of the Division Engineers.

ENLARGEMENT OF THE CHAMPLAIN CANAL.

By act, chap. 788, Laws of 1870, the State Engineer and Surveyor was authorized to cause a survey and estimate to be made for the enlargement of the Champlain canal.

The act provides the enlargement to be made in such a manner as to give, throughout its entire length, a uniform depth of seven feet of water, fifty-eight feet width at surface of same, and forty-four feet width at the bottom.

The following is the estimated cost of enlargement upon this basis :

1st Division, West Troy to Fort Miller,	29 $\frac{76}{100}$ miles,	\$1,520,345 27
2d Division, Fort Miller to Whitehall,	33 $\frac{88}{100}$ miles,	1,330,229 45
Total.....	63 $\frac{64}{100}$	<u><u>\$2,850,574 72</u></u>

For the estimates in detail and descriptions, I refer you to the accompanying report of the Division Engineer.

IMPROVEMENTS RECOMMENDED.

In regard to an additional supply of water upon and east of the "long level," I still retain the opinion expressed in my two last annual reports upon the construction of "Fish creek feeder." Objections against this important improvement have been made by the citizens of Oswego. In reply to these I quote from my last report the following passage on this question:

"It has been shown in former official reports that the State, by the construction of the Erieville, De Ruyter, Cazenovia lake and Skaneateles lake reservoirs, together with the waters drawn from Lake Erie and the Chemung river, has largely increased the flow of the Oswego river, during the dry part of the year, over that of its natural drainage. Assuming that no addition to its flow has been contributed by the State, then that part of the waters of Fish creek diverted for the use of the long level and not returned to this river through the Oneida lake canal, and at the Lodi lock, is so small that it could be easily and fully made up by the construction of compensating reservoirs at the head waters of Fish creek, which it has been ascertained by recent examinations could be constructed at a small expense.

"The estimated cost of constructing this feeder, whereby a supply of 8,000 cubic feet of water per minute will be secured, is \$693,250.

"By reference to the Division Engineers' report, it will be observed that the improvements suggested in my last annual report of 'improving the lockage facilities by the application of Heath's patent at lock No. 37, Erie canal,' has, thus far, met with partial success. Further experiments are necessary before making its adoption general."

For details of what has been accomplished in the matter, reference

may be had to the forthcoming report of the commissioners appointed by said act.

NAVIGATING THE CANALS BY STEAM.

The suggestions made upon this important subject in my last two annual reports, have been, to a certain extent, carried out in the passage of act, chap. 868, Laws of 1871.

Having witnessed in November last several interesting experiments upon the plan of steam towing known as the "Belgian system" put in operation under the provisions of act, chap. 576, Laws of 1870, by the "New York Steam Cable Towing Company." The following is a general description of this method.

An iron or steel wire rope, of from one-half inch to one inch diameter, according to circumstances, is laid down in the bottom of the canal or river, following the bends and the curves of the water-course, resting uninterruptedly through or over locks, and being fastened only at the two extreme ends of the canal.

A steam engine, portable or fixed, is placed on the vessel which has to be towed, or which may serve as tug for towing other boats. This engine works one of Fowler's clip drums, a pulley of peculiar construction, which requires here a more detailed description.

It consists of a cast-iron wheel, the circumference of which, forming the groove of a pulley, is provided with a number of movable clips, turning round steel centers. These clips, each pair about two and a half inches long in the direction of the circumference, nearly touch each other, and form thus a complete movable groove, into which a rope may be placed. The centers of the clips are so arranged that the rope, pressing into the groove by its own strain, produces a slight movement of the clips toward the center of the drum, narrowing thus the space in which the rope rests. This will produce a certain pressure of the clips against the rope, which increases with the force with which the rope is pressed into the clips, and which again is in proportion to the strain exerted by the rope. It is, therefore, clear, that with a very small strain in what is called the back or slack rope, a very considerable strain in the pulling or front rope can be exerted without any danger of slipping, as the friction between rope and pulley increases in proportion to the power exerted.

Without entering into detail, it is fair to presume (all things being equal) that this method of "clip drum" and cable towing saves the power lost by the slip of the screw or paddle of other methods in

propelling against the water, of from forty-five to sixty per cent. This reduction of power, weight of machinery, and consumption of fuel to accomplish the same results, is a great step, in point of economy, toward the successful introduction of steam upon our canals.

Respectfully submitted.

VAN R. RICHMOND,

State Engineer and Surveyor.

EASTERN DIVISION.

ANNUAL REPORT OF E. H. CROCKER, DIVISION ENGINEER, FOR 1871.

DIVISION ENGINEER'S OFFICE,
ALBANY, October 1, 1871. }

HON. VAN R. RICHMOND, *State Engineer and Surveyor* :

SIR.—In accordance with the regulations established under act, chapter 169, Laws of 1862, I have the honor to present you my Annual Report.

The navigable canals, river improvements and feeders, remain the same as last year, and are as follows :

	Miles.
Erie canal from Albany to east bank of Oneida Lake canal..	133.58
Albany basin (called 1 mile, for tolls, chap. 200, Laws of 1849),	.77
Port Schuyler and West Troy side cuts.....	.35
Pond above Troy dam.....	3.00
Champlain canal and Waterford side cut.....	66.00
Glen's Falls feeder and pond above	12.00
Black River canal.....	35.33
Black River feeder and pond above dam.....	12.09
Delta feeder	1.38
Black River improvement.....	42.50
Total Eastern Division	307.00

FEEDERS NOT NAVIGABLE.

Mohawk river at Rexford Flats.....	0.39
Schoharie creek.....	0.63
Mohawk at Rocky Rift.....	3.92
Mohawk, south side, at Little Falls.....	0.19
Mohawk, north side, at Little Falls, partly navigable.....	0.50
Mohawk at Rome.....	0.05
Oriskany Creek, temporary.....	0.53
Total	6.21

RESERVOIRS.

NAME.	Area of surface in acres.	Average area in acres.	Depth in feet.	Capacity, cubic feet.
Woodhull.....	1,326	1,118	18	876,550,000
North Branch (can be filled twice yearly).....	423	277	23	310,000,000
South Branch.....	518	372	26	421,190,000
Total.....	2,177	1,767	.....	1,607,740,000

SUPPLY OF WATER FOR ERIE CANAL.

On the 4th of August last, the Canal Board, under chapter 767, Laws of 1870, authorized the Canal Commissioner in charge to construct Sand Lake Reservoir, by damming Sand Lake at a point about one and a half miles below Woodhull reservoir, and diverting into it the waters of the third Bisby lake. By raising this lake fifteen feet, a reservoir can be obtained, whose area of surface will be 344.50 acres. Average area, 305.81 acres, and capacity, 199,879,822 cubic feet, capable of furnishing, for 100 days, an additional supply of 1,388 cubic feet of water per minute. It is thought this reservoir can be filled twice yearly.

SOURCE.	Distance to be supplied, in miles.	Quan. furnish- ed in cub. ft. per minute.
Champlain canal from Mohawk at Cohoes.....	7	6,570
Mohawk river at Rexford's Flats.....	20	19,979
Schoharie creek.....	25	6,800
Mohawk at Rocky Rift.....	27	10,602
Mohawk at Little Falls.....	9	12,643
Ilion creek.....	800	
Chenango canal.....	911	
Butta' creek, 2½ miles east of Rome.....	1,400	
Mohawk and Black rivers at Rome.....	11,766	
Black River canal.....	1,224	
Wood creek at Rome.....	125	
Oriskany creek (temporary).....	4,300	
Total.....	136	68,190

SUPPLY OF WATER FOR CHAMPLAIN CANAL.

From the junction with the Erie at West Troy, to a point one mile north of Waterford, a distance of five miles, the supply is from the Mohawk river at Cohoes; from one mile north of Waterford to the crossing of the Hudson river, two and a quarter miles south of Fort

Miller, a distance of twenty-five miles, the supply is from the Hudson river at Saratoga dam; from that point to Whitehall, a distance of thirty-five miles, the supply is from Glen's Falls' feeder and Wood creek.

SUPPLY OF WATER FOR BLACK RIVER CANAL.

From the junction with the Erie canal at Rome to lock No. 9, seven miles, the supply is from Delta feeder, taken from the Mohawk river; from lock No. 9 to lock No. 34, ten miles, the supply is from Lansing Kill feeder; from lock No. 34 to lock No. 102, seventeen miles, the supply is from Black River feeder; from lock No. 102 to lock No. 109, one and a third miles, the supply is from pond above dam at Lyon's Falls.

The water furnished by the reservoirs is drawn only in the very dry season, and passed down through the natural channel of Black river and Woodhull, about twenty miles each to the pond above dam at head of Black River feeder, thence the necessary quantity is taken into said feeder and passed to the summit level at Booneville. From this point the canal is supplied both ways, and the balance, designed for the use of the Erie canal, is passed off by a waste-weir into the Lansing Kill at the south end of the summit, thence into the Mohawk river, from whence it enters the Erie canal by the feeder at Rome.

ENGINEERING DEPARTMENT.

On the last day of the fiscal year the number of persons employed in this department, exclusive of the Division and Resident Engineers, was twenty-two; of these thirteen were employed on the Erie canal, three on the Erie and Champlain, and six on the Champlain.

The annexed table, No. 1, exhibits the name, rank, period of service and compensation of all persons so employed, and the amount expended for engineering during the fiscal year.

Act chap. 169, Laws of 1862, places the ordinary repairs of the canals under the general supervision of the engineers appointed by the Canal Board, and the expenditures for engineering under this head are as follows:

Repairs Erie canal.....	\$3,620 05
Repairs Champlain canal.....	1,936 68
Repairs Black River canal.....	817 00
Total.....	<u>\$6,373 73</u>

The expenditures for engineering on the improvement of the Champlain canal under act chap. 186, Laws of 1864, during the fiscal year, are \$1,577.04.

The expenditures during the fiscal year, on the survey for the enlargement of the Champlain canal, under act chap. 788, Laws of 1870, and survey for Sand Lake reservoir, under act chap. 877, Laws of 1869, are as follows :

Survey for enlargement Champlain.....	\$15,035 30
Survey Sand Lake reservoir.....	1,494 75
Total.....	<u>\$16,530 05</u>

The work on ordinary and extraordinary repairs ordered by Canal Board, and authorized by general and special laws, has been under the supervision of the engineer department, and the expenditures for engineering were paid by the commissioner in charge, and are as follows :

Extraordinary repairs, Erie canal.....	\$19,670 00
Extraordinary repairs, Champlain canal.....	5,406 00
Extraordinary repairs, Black River canal.....	395 00
Total	<u>\$25,471 50</u>

The expenditures for engineering on this division, including those on the surveys for the fiscal year, are as follows :

Ordinary repairs.....	\$6,373 73
Improvement Champlain canal	1,577 04
Survey, enlargement Champlain canal.....	15,035 30
Survey, Sand Lake reservoir.....	1,494 75
Extraordinary repairs	25,471 50
Total	<u>\$49,952 32</u>

The following comparative tables, A, B and C, show the amount of work done during the fiscal years ending September 30th, 1869-70 and 1871, the cost of engineering and superintending, and the percentage :

TABLE "A."

NAME OF CANAL.	1869.			1870.		
	Work done.	Engineering including surveys.	Per-centage.	Work done.	Engineering including surveys.	Per-centage.
Erie	\$183,177 20	\$31,061 82	11.50	\$352,390 46	\$26,566 59	7.53
Champlain ..	236,873 91	15,434 64	6.51	374,770 53	25,396 88	6.77
Black River ..	14,193 82	4,532 60	31.80	53,956 00	2,200 92	4.00
Total	\$424,244 93	\$41,029 06	9.4-10	\$781,116 99	\$54,164 34	6.9-10

TABLE "B."

NAME OF CANAL.	1869.			1871.		
	Work done.	Engineering excluding surveys.	Per-centage.	Work done.	Engineering excluding surveys.	Per-centage.
Erie	\$183,177 20	\$15,361 57	8.38	\$352,390 46	\$23,883 88	6.70
Champlain ..	236,873 91	15,434 64	6.51	374,770 53	15,947 81	4.25
Black River ..	14,193 82	4,130 60	23.00	53,956 00	1,568 92	8.00
Total	\$424,244 93	\$34,926 81	8.	\$781,116 99	\$41,400 61	5.3-10

TABLE "C," 1871.

NAME OF CANAL.	INCLUDING AMOUNT EXPENDED ON ENGINEERING AND SURVEYS.			EXCLUDING AMOUNT EXPENDED ON ENGINEERING AND SURVEYS.		
	Work done.	Engineering.	Per-centage.	Work done.	Engineering.	Per-centage.
Erie	\$296,762 67	\$24,784 80	8.35	\$296,762 67	\$23,290 05	7.85
Champlain ..	346,268 28	23,955 52	6.90	346,268 28	8,920 22	2.57
Black River ..	43,719 86	1,212 00	2.70	43,719 86	1,212 00	2.70
Total	\$686,750 81	\$49,952 32	7.2-10	\$686,750 81	\$33,422 27	4.8-10

WORKS ON THE DIFFERENT CANALS.

The amount of work done during the fiscal year on all the canals under the immediate supervision of this department, is as follows :

Erie Canal.

Ordinary repairs under contract	\$63,136 00
Extraordinary repairs under contract...	222,016 23
Extraordinary repairs not under contract	11,610 44
	<u>\$296,762 67</u>

Champlain Canal.

Ordinary repairs under contract.....	\$120,644 63	
Extraordinary repairs under contract ...	145,367 60	
Extraordinary repairs not under contract,	26,887 74	
Improvement, Champlain.....	53,368 31	
		<hr/> \$346,268 28

Black River Canal.

Ordinary repairs under contract.....	\$800 00	
Extraordinary repairs under contract ...	18,051 45	
Extraordinary repairs not under contract,	24,868 41	
		<hr/> 43,719 86
Total	\$686,750 81	<hr/> <hr/>

DESCRIPTION OF WORK DONE DURING THE YEAR.

Erie Canal — Ordinary Repairs.

The annexed table, No. 3, is an exhibit of the expenditure under this head; and, aside from dredging the Albany basin, nothing of consequence has been done under the supervision of this department.

Extraordinary Repairs.

Table No. 2 shows how many pieces of work have been under contract during the year, the progress of each, and the number completed.

The following, authorized by Laws of 1869, have been completed :

Sluice at Cohoes guard lock; removing wall benches, etc., and constructing vertical walls at Utica and Rome; lengthening culvert at Frankfort; cast iron arch truss bridge at Fonda street, Schenectady, and at Schuyler street, Utica; also an iron highway and tow-path bridge, connected just above lock 18, authorized by Laws of 1871.

The following work, provided for by general laws, and done by the Commissioner in charge, under the authority of the Canal Board, has been completed :

Two farm bridges and a ditch on the Rocky Rift feeder; lengthening the west abutment of White street bridge, Cohoes, and removing original bottom and improving the Erie canal, in connection with it, on the berme side, just above lock No. 39. This latter work was completed and ready for navigation last spring, and it has proved of great benefit during the past season.

The machinery for utilizing the feed water, at lock No. 37, authorized by resolution of Canal Board, on the eighth day of December last, and for which an appropriation of \$4,000 was made by chapter 930, Laws of 1871, has been completed and in operation.

The work was done by George Heath, the projector of the plan, under the supervision of the Division Engineer and Commissioner in charge. The cost will exceed the appropriation, and the balance will have to be provided for. In operating his machinery, Mr. Heath uses the feed water, which is constantly passing from the upper to the lower level, down through the well and culvert. It is applied to a water wheel, located in the well at the head of the locks, and by means of his machinery, thus operated, opens and shuts the tumble and lower miter gates, and draws boats into and out of the lock with marked ease and rapidity.

The machinery seems to operate very satisfactorily, and while I am not fully prepared to recommend its immediate adoption, until it has been more thoroughly tested, I am quite inclined to the belief that important results may grow out of it, one of which will be the saving of water in times of its scarcity, by doing away with the hitherto almost universal practice of flushing boats into and out of the locks.

In connection with this, I subjoin the following statement, made by Mr. Heath:

E. H. CROCKER, *Division Engineer, Albany:*

SIR.—Having taken the measurements of the lock and boats, and noted the time to perform one lockage, I take great pleasure in sending you the subjoined statement, showing the amount of water saved to the canal for each down locking of a loaded boat by the use of my “machinery for utilization of feed water,” and have endeavored to make it as plain as I could, so that you may understand how my calculations were made:

It requires to flush a boat into the lock, one-half of valve A opening=13 inches \times 48 inches; time say $1\frac{1}{2}$ min., and 6.71 cub. ft. of water per sq. in. per min. and 10 feet head= $13'' \times 48'' \times 1\frac{1}{2}$ min. \times 6.71 cub. ft.=.....	6,280.56 cub. ft.
To flush boat out of lock= $26'' \times 48'' \times 1\frac{1}{2}$ min. \times 6.71 cub. ft.=.....	12,551.12 “ “
Add amount of water to fill lock $110' \times 18' \times 10'$	
less amount displayed by boat= $19,800 - 9,000 =$	10,800.00 “ “
Amount used at one locking by flushing.....	<u>29,631.68 “ “</u>

By machinery for utilization of feed water—amount of water used for one lockage is amount used by wheel=4.19 cub. ft. per min. and time 4 min., we have $4.19 \times 4 \text{ min} = \dots\dots\dots$	16.76 cub. ft.
Add water in lock $110' \times 18' \times 10'$ less amount displaced by boat= $19,800 - 9,000 = \dots\dots\dots$	10,800.00 “ “
Amount of water by machinery for one lockage..	<u>10,816.76 “ “</u>
Flushing system—amount of water used for one down locking loaded boat.....	29,631.68 “ “
Machinery system—amount used.....	<u>10,816.76 “ “</u>
Amount saved in one down locking.....	<u>18,814.92 “ “</u>

For one day's locking of 140 boats down we have saved 18,824 cub. ft. $\times 140 = 2,635,360$ cub. ft.

This amount of water saved daily for a boating season of 200 days will fill 223 miles of canal the size of the Erie.

The saving to the State in lock tending will be four men

$\times 7\frac{1}{2} \text{ months} \times \$40 \dots\dots\dots$	\$1,200
Two men $\times 7\frac{1}{2} \text{ months} \times \$50 \dots\dots\dots$	<u>750</u>

Amount saved by use of machinery..... \$450
per lock for season of $7\frac{1}{2}$ months.

Very respectfully,

Your obedient servant,

GEO. HEATH.

Lock No. 2 is in process of construction and will be completed probably and brought into use next spring.

The iron sidewalk bridge at Summit street, Cohoes, is ready to be placed upon the abutments, and will be put up when the water shall have been drawn off.

Work on the bridge at Ilion has been suspended for want of funds. A further appropriation of \$1,500 will be required to finish it.

The work on the side-cut locks at West Troy has been suspended, owing to the unfortunate failure of the last Legislature to reappropriate the funds for that object.

Nothing has as yet been done on the stone dam across the Hudson river at Troy, for which \$40,000 was appropriated by Laws of 1869, and the further sum of \$10,000 by Laws of 1870.

The greater portion of the work let under laws of 1869, 1870 and 1871, including the removal of the old wall-benches, has made reasonable progress.

The lengthening of Schoharie Creek dam, which was let last winter, will be completed this fall, and will be a valuable improvement to that structure. Its length will have been increased from 436 to 588 feet. The cost of the work will exceed the amount appropriated, and a further appropriation will be necessary to settle the account.

During the month of August last, it became evident, on account of the vast increase of business on the Erie canal, and the increase of lockages over past seasons, that a scarcity of water for purposes of navigation was imminent, and that serious embarrassments to the same were threatened; hence, something had to be done to meet the emergency. The Commissioners at once looked the ground over and decided upon Oriskany creek as the source from which to obtain the necessary supply in the shortest space of time. Accordingly a survey was made, and a large force of men and teams employed to construct a temporary feeder; within a little over a month from the time of its commencement, the feeder was brought into use, and has been invaluable as a temporary relief. The Commissioner in charge of the Eastern Division is entitled to much credit for his prompt action and personal efforts in bringing about this result.

CHAMPLAIN CANAL.

ORDINARY REPAIRS.

Table No. 3 shows work done and in progress, and what portion of the cost is chargeable to the revenues from the canals, the balance being provided for by tax.

EXTRAORDINARY REPAIRS.

The stone dam across the Mohawk river at Cohoes, let by the Canal Board in April, 1868, will be completed this fall. It will have been constructed at a large cost, including unavoidable damages done by freshets, but it will be a noble and enduring structure long after the present generation shall have passed away.

The dredging of the Whitehall basin, authorized by the Laws of 1868, 1869 and 1870, has been in progress. Vast amounts of deposit have been removed and the basin has been much improved. The

elbow at the north end, which has always been a great impediment to navigation, has been in a measure straightened and greatly improved.

The following work, authorized by Laws of 1869 and 1870, has been completed: guard lock, head of Glen's Falls feeder; vertical wall and stop gate at Fort Edward; Flynn's lock, and a wrought-iron road and tow path bridge at Fort Edward.

The following work, authorized by the same laws, has made satisfactory progress: Saratoga (stone) dam; vertical wall at Sandy Hill; improvement at Waterford, and the improvement from south guard lock above Schuylerville to Bullard's Bend. The Canal Commissioners, under the Laws of 1871, put under contract the *two* locks at the "Three locks" above Waterford, to be completed in the spring of 1873.

Chapter 930, Laws of 1871, provided for two stop gates at the mouth of the Glen's Falls feeder, to be completed and ready for navigation last spring, and to be done by contract, or otherwise, as the Commissioners might decide; accordingly, upon the estimate of the engineer, the Canal Board authorized the Commissioners to proceed and do the work as the law provided. It was completed and ready at the opening of navigation.

The dam across the Hudson river, at the head of the Glen's Falls feeder, authorized by chapter 877, Laws of 1869, was placed under contract in August, 1870.

In due time the contractor was notified to proceed with the work. He visited the site of the proposed structure, and after a careful examination, decided that the work could not be done according to plans and specifications at his contract prices; he subsequently concluded to abandon his contract (which he did the following winter) rather than incur the risk of heavy loss in the fulfillment of it.

On examination, the old dam being found in very bad condition, in fact, liable to go out at almost any time, and the forwarders and business men on the Champlain Canal having urged the Commissioner in charge to rebuild it at the earliest possible period, he finally determined, under the authority and permission of the Canal Board, to reconstruct the dam by day labor. About the first of February the work was commenced, and has been vigorously pushed forward ever since. It will be finished this year, and when completed will be one of the handsomest and most enduring structures of the kind on this division. It is being constructed strictly in accordance with the plans originally adopted by the Canal Board.

The probabilities are that the total cost will be quite in excess of the engineer's estimate, as much more work was found necessary to be done on both sides of the river than was anticipated at the time the estimate was made. Some two or three thousand yards of rock were removed from the bed of the river on the north side to allow freer passage of the water into the feeder, and upon the south side the distance between the bed of the stream and the rock (upon which the whole structure rests throughout its entire length) was found to be much greater, thus involving more excavation to reach it, and a much greater expense for bailing and draining and heavier protection masonry, extending from the rear of the south abutment to the foot of the hill, so as to completely fortify that end of the dam against high freshets.

The item of bailing and draining has been very expensive, it being necessary to construct about 1,100 lineal feet of coffer dam, eighteen feet high and twenty feet wide; this could not be avoided, as it was impossible to maintain navigation on the Champlain canal without it. When this very important structure shall be completed, there will be an abundant supply of water for the Champlain canal for years to come, and there need be no apprehensions as heretofore of suspension of navigation on that canal on account of the failure of the feeder dam.

The Commissioner in charge of this division should receive the thanks of every business man on the line of this canal for so resolutely putting this work in such a substantial condition.

IMPROVEMENT CHAMPLAIN CANAL.

The annexed table, No. 2, shows the amount of work done under this head during the fiscal year.

In accordance with the recommendations in my last annual report all the old contracts then in existence have been closed and the final accounts settled, as shown by the table. This should have been done long since as, under the Laws of 1864 for the improvement, there seems to have been no fixed plans to work to, as well as no limit to doing work under the contracts, and hence a large amount of money was expended without any substantial benefit. Under chapter 788, Laws of 1870, it will be different, as an accurate and careful survey has been made, maps and plans adopted and placed on file, according to which all new work is to be done hereafter.

It will be necessary for the Legislature to make a further appropriation to pay the certified drafts given in settling the improvement accounts.

BLACK RIVER CANAL.

ORDINARY REPAIRS.

What has been done under this head, in addition to the ordinary repairs of the canal, may be seen by reference to table No. 3:

The iron bridge at Dominick street, Rome, has been completed, and that at Booneville will be completed this fall.

EXTRAORDINARY REPAIRS.

By reference to table No. 2, it may be seen what work has been in progress, and what completed during the fiscal year.

The work on the bridge over the Black river at Parker's Landing, has long been suspended for want of funds. A further appropriation is necessary to complete it.

The work of inserting cast iron discharge pipes at Woodhull reservoir, has been completed, and the reservoir put in a condition to need no further repairs for many years.

GENERAL IMPROVEMENTS.

In addition to the work under contract, some thirty-six (36) miles of the old wall-bench, on the tow-path side, still remain in the canal on this division. Wherever it has been removed, taking into account the manner in which it had worked into the center of the canal, at least twenty-five per cent has been added to the efficiency of the prism. There is no improvement more important than this, and none that would be of so much benefit to navigation. There are some points where the old bench is very bad; it is a constant obstruction and annoyance, and should be taken out at the earliest possible period.

But for the small appropriation for this purpose, last winter, these places would have been put under contract the present year.

The bench still remaining on the tow-path side, not under contract, is distributed as follows:

	Miles.
Between lock 23 and Fultonville.	5.80
Between Sprakers and Little Falls.	15.50
Between Little Falls and Utica.	12.00
Between Newville and Wood creek.	2.50
Total	<u>35.80</u>

Just as soon as the money shall be provided, those portions from Sprakers to Canajoharie, and from lock 45 to Utica, should be put under contract. Further and immediate appropriations should be made for this object.

George Heath's "tumble gate" has been very thoroughly tested, and merits recommendation. It should be put into every lock, the lift of which is six feet or over. It is easily and more quickly operated, and much tighter than the miter gate. It has been inserted at locks 37, 39, 44 and 45 on the Erie canal, and at Flynn's, Hewitt's, Becker's, Fort Miller and Moseskill (new enlarged) locks on the Champlain, and found to work entirely satisfactorily.

This gate, in connection with the utilizing machine (if a success) referred to in another part of this report, will prove important water-saving agents.

As recommended in my last annual report, this gate should be inserted into locks Nos. 21 and 22, Erie canal, immediately.

CHAMPLAIN CANAL.

"The old junction locks" at Cohoes, which were built on the enlarged size, are very much decayed and very soon will have to be rebuilt. I doubt whether they can be made to last longer than another season. They are liable to fail at any time. They were built in 1860, of wood; are combined, and eleven feet eight inches lift each. When rebuilt they should be separated, as shown on enlargement map, and by all means be built of stone. The guard-lock on the north side of the Mohawk river at Cohoes, built at the same time, also of wood, has about served its time, and is in need of being rebuilt of stone.

That portion of the river bank between this lock and the abutments to the new stone dam should be better protected with either rip-rap, heavy slope or vertical wall; also the bank on the south side, between abutment and guard-lock, should be raised and substantial vertical wall in cement laid up. This is more necessary on account of the speedy completion of the stone dam across the river at this place. This dam will be perfectly tight, and will contribute towards raising the water still higher in time of freshets.

The Schuylerville aqueduct (the center pier of which gave way last July) should be rebuilt and located farther north.

Dunham's Basin waste-weir will need rebuilding the coming winter.

There are some important improvements that might be made on the Glen's Falls feeder between its mouth and the head of the thirteen locks. One of the most important is the construction of a crib-pier extending from the berme wing of the lower of the five combined locks, down some hundred or more feet, to serve as a break-water against the mouth of the long sluice around these locks. It would add very much to the facility of navigating that level and entering the lower lock. Lock No. 11, which was built of wood in the spring of 1856, should be rebuilt of stone the coming winter and spring.

The leaks in the Glen's Falls feeder, through the fissures of the rocks, have again become enormous. It will be necessary to give them early attention.

I have no doubt but that as much water is wasted through these leaks as is taken into the main canal at the mouth of the feeder.

There are a few points on this feeder where the banks are of sand, very porous, and in the spring of the year when the water is first let in percolates through the banks and causes slides, and, in a few instances, has well-nigh caused disastrous breaks. One of the worst of these places extends from a point about 200 feet east of Brown's bridge to a point 300 feet west of the same. Vertical wall laid in cement and grouted should be put in at this place the coming spring. A break here would prove very disastrous and expensive to repair.

ENLARGEMENT.

In my last annual report I had occasion to refer briefly to the survey for the enlargement of the Champlain canal under act chapter 788, Laws of 1870.

On the 14th of February following I had the honor to transmit to you on the subject the following report:

DIVISION ENGINEER'S OFFICE,
ALBANY, February 14, 1871. }

HON. VAN R. RICHMOND, *State Engineer and Surveyor*:

SIR.—Act chap. 788, Laws of 1870, provides for the enlargement of the Champlain canal in such a manner as to give throughout its entire length a uniform depth of seven feet of water, a width on the bottom of forty-four feet, and at water surface a width of fifty-eight feet except as in the opinion of the Canal Board may be required for business purposes, in which case the walls may be made vertical, retaining the same surface width.

Section three of the same act makes it the duty of the State Engineer to make, or cause to be made, at the earliest time practicable, the necessary surveys, maps, plans and estimates of such proposed enlargement. In compliance with this provision, you directed me in the month of June last to organize the necessary forces and proceed to make the necessary surveys, etc.

In obedience to your directions two parties were accordingly organized and entered upon duty the first day of July following. One in charge of S. E. Babcock, Esq., on that portion of the line extending from its junction with the Erie canal at West Troy to the south end of Fort Miller bridge, above Schuylerville, the other in charge of W. B. Cooper, Esq., on that portion extending from Fort Miller bridge to Whitehall.

Both parties were assiduous in the prosecution of their respective duties, and closed their field work in the early part of December, at which time several of each party were discharged, those only being retained whose services were necessary for the office work on maps, plans, estimates, etc.

The method of the survey has been in accordance with that prescribed in the established regulations.

As a general thing, the line of the new survey coincides with the old line, departures being made only when the line could be straightened and improved, and as economically built.

The maps, plans and estimates, which I herewith respectfully submit for your examination, have been prepared with great care, and hence are invaluable, especially the maps, for future reference and use, even in the event of not proceeding immediately with the enlargement.

By reference to the abstracts of estimated quantities and prices it will be seen that the estimated cost of enlarging the Champlain canal, throughout its entire length, to the dimensions prescribed in the act, is as follows :

First division, extending from junction at West Troy to south end of Fort Miller bridge, 29 76-100 miles.....	\$1,520,345 27
Second division, extending from south end of Fort Miller bridge to the village of Whitehall, a distance of 33 88-100 miles.....	1,330,229 45
Total, 63 64-100 miles.....	<u>\$2,850,574 72</u>

This estimate covers everything except the cost of constructing two lift locks in place of the "Three locks," north of Waterford, the major portion of the cost of which will be chargeable to the revenues; the remainder it is expected will be provided for by tax this winter, also the enlargement of the guard lock on Wood creek, five miles south of Whitehall, at a cost over old plan not to exceed seven thousand dollars (\$7,000).

In connection with this a survey was made to ascertain the cost of constructing an independent line of canal outside of Wood creek, extending from the lower lock at Fort Ann village to the guard lock north, a distance of six miles. To construct this line and make it entirely independent of said creek, will involve the construction of one aqueduct, two lift locks, of three feet each, one dam and bulk-head and a feeder a half a mile long, four road bridges, four farm bridges, one railroad bridge, one change bridge, two box culverts, and an appropriation of about ninety acres of land, at an estimated cost of..... \$364,400.

Estimated cost, as per old line, with proposed improve-	
ments, as shown by maps.....	80,775
Excess.....	<u>\$283,625</u>

It would also be necessary to occupy about one mile of the Rensselaer and Saratoga railroad line, and throw the same parallel with itself westward.

This independent line, if built, would be free from the frequent annoyances and delays occasioned by high water, be much less expensive to maintain, and would possess otherwise many advantages.

The plans and specifications for the mechanical structures are generally similar to those adopted for the Erie canal enlargement, varied to correspond with the breadth of prism, and with a view to economy in the character of the work, changed as regards masonry.

The locks on this canal consist of twenty-three lift (including the three side cut at Waterford), one weigh and four guard locks, all of which have been enlarged to the size of the Erie locks, except Flynn's, four and a half miles north of Waterford and the "Three locks" just north of Waterford, and the guard lock on Wood creek, five miles south of Whitehall. Provision has been made for the construction of Flynn's lock on the enlarged size, and it is now under contract to be completed on the 1st of May next.

The "Three locks" need rebuilding immediately, and when done it is designed to dispense with the middle one, and construct only two with equivalent lifts. The only one then remaining to be enlarged will be the guard lock on Wood creek, which can be done at a trifling cost.

The weigh-lock at Waterford, constructed in the winter and spring of 1861-2, was built to accommodate the largest class of Erie canal boats; hence on the 1st of May next there will remain to be enlarged only one guard and two lift locks.

AQUEDUCTS.

There are now four small aqueducts on the old canal. One of them has been built with reference to enlargement; and the other three, with slight alterations, and at a nominal expense, can be adapted to the proposed prism. In order to secure sufficient water way for the stream just below Flynn's lock, it will be necessary to convert the culvert now there into a small aqueduct of one span only.

Act chapter 767, Laws of 1870, provides for an aqueduct at Wilbur's basin, or creek, and appropriates \$20,000 to pay the cost of construction. This will be built on the enlarged size, perhaps within the next eighteen months.

CULVERTS.

There are on the present old canal nineteen culverts, eleven arch and eight box. The greater portion of them will have to be lengthened only; the balance entirely rebuilt. In order to insure safety, and to prevent the rapid accumulation of drift and sediment in the canal, thereby forming bars and obstructions to be removed every spring at quite an expense, it will be necessary to construct a new arch culvert, at Pratt's farm, station 530, and one at Leland's farm, station 821, and a box culvert just above Wilbur's basin, at station 1623.

WASTE-WEIRS.

Of these structures there are fourteen, all of which it will be necessary to take up and rebuild, with the exception of two, one at Wilbur's basin, and the other one mile north. Four-fifths of them are small, cheap structures, and it is proposed to rebuild and enlarge them on a substantial but economical plan, conforming to the enlarged prism.

BRIDGES.

There are, on the old canal, seventy-one road bridges (sixty-six wood and five iron); seventy-six farm; seven change (five wood and two iron), and seven railroad bridges, all of which will require lengthening and raising, except eleven road (seven wood and four iron), and three change bridges (two iron and one wood). In a majority of cases, it will only be necessary to take down and rebuild one abutment to each bridge.

The general plan of farm and road bridges, proposed for the enlargement, is that of Whipple's wood truss, with wrought-iron chords and cast-iron shoes.

I am convinced, from observation and experience, that this style of bridge is about as durable and economical as any of its class. As decay and failure first begin with the bottom chords, at the toe of the braces, it is obvious that the substitution of iron for wooden chords must add a large percentage to the life of the structure. The general clear span of a right angular bridge is fixed at sixty-four feet.

DAMS.

There are six dams on the canal: one across the Mohawk river at Cohoes; one across the Hudson river at Fort Miller bridge; one at the head of the Glen's Falls feeder; and three on Wood creek.

The first three are long and important ones, and are being rebuilt; those at Cohoes and Fort Miller bridge, of stone, and that at the head of the Glen's Falls feeder, of wood and stone; all with reference to a depth of seven feet of water on the mitre sill at low water. Means have been provided for their completion.

Of those on Wood creek, near Whitehall, two are of stone and one of trees, all built some years ago, and with reference to enlargement.

As regards the supply of water for this canal there need be no apprehension. From its junction with the Erie canal at West Troy to the "Three locks" above Waterford, a distance of five miles, the supply will be, as now, from the Mohawk river at Cohoes; from the "Three locks" to Fort Miller bridge it will be from the Hudson river; from Fort Miller bridge to Whitehall, it will be from the Hudson river and Wood creek.

The following are the reports of Messrs. Babcock and Cooper on this subject:

ENGINEER'S OFFICE,
WEST TROY, February 13, 1871. }

E. H. CROCKER, *Division Engineer*:

SIR.—I submit herewith an estimate of the quantity of water required to supply the first division of the Champlain canal, extending from West Troy to Saratoga bridge, enlarged as proposed by act chap. 788, Laws of 1870, viz.: forty-four feet bottom width; fifty-eight feet surface, and seven feet depth of water, with slope one to one.

From West Troy to Waterford the supply will be from the Mohawk river at Cohoes, upon which I have not thought it necessary to make an estimate; the quantity being deemed amply sufficient. From Waterford to Saratoga dam the supply will be from the Hudson river.

The capacity of the bulkhead at the guard-lock at Saratoga dam is 25,272 cubic feet per minute.

My estimate in detail accompanying this report shows the amount of water required from Saratoga dam to Waterford, a distance of 26.25 miles, to be 6,770 cubic feet per minute, as follows:

	Cubic feet per minute.
Evaporation and filtration.....	3,641
Leakage from locks.....	1,602
" at aqueducts.....	37
" " waste-weirs.....	200
Lockage water required.....	1,290
Total.....	<u>6,770</u>

SUPPLY.

Capacity of bulkhead at Saratoga dam.....	<u>25,272</u>
Surplus.....	<u>18,502</u>

Estimating the total number of lockages per day at two hundred, the estimated full capacity, the amount of water required to operate this division would be 9,085 cubic feet per minute; still leaving a surplus of 16,187 cubic feet per minute.

Respectfully submitted.

S. E. BABCOCK,
Assistant Engineer.

ENGINEER'S OFFICE,
FORT EDWARD, February 13, 1871. }

E. H. CROCKER, *Division Engineer* :

SIR.—With this I inclose an estimate of the amount of water required to supply the Champlain canal, enlarged as proposed by act chapter 788, Laws of 1870.

* * * * *

I have not deemed it necessary to make any estimate of the amount required from Fort Ann to Whitehall, as we have, in addition to lockage water and leakage from Fort Ann locks, the water of Wood creek and Half-way brook, and drainage of Whitehall level. My estimate in detail accompanying this shows the amount required from Fort Ann to Hudson river, at Fort Miller bridge, a distance of 22.2 miles to be 8,355 cubic feet per minute, as follows :

	Cub. ft. per min.
Evaporation and filtration	3,245
Leakage from aqueducts.....	53
Leakage at waste weirs.....	200
Leakage at locks.....	2,564
Evaporation and filtration, Glen's Falls feeder.....	660
Lockage water northerly.....	624
Lockage water southerly.....	1,009
Total.....	<u>8,355</u>

To supply which we have the Glen's Falls feeder, with capacity of 23,375 cubic feet per minute, with a dam and bulkhead of 25,275 cubic feet per minute.

I have made no allowance for the extraordinary leakage in the Glen's Falls feeder, which, I assume, will be stopped.

Respectfully submitted.

W. B. COOPER,
Assistant Engineer.

On the completion of the new dams now in progress at Cohoes, Fort Miller bridge, and at the head of the Glen's Falls feeder, the supply of water must be sufficient beyond a question.

Whenever the two locks in place of the "Three locks" above Waterford shall be built, that portion of the canal extending thence to Hewitt's lock, a distance of $4\frac{3}{4}$ miles, should be enlarged, as the

dispensing with one of the "Three locks" involves the changing of the level in elevation from twelve to fifteen inches.

In conclusion, I desire to express my appreciation of the efficient services rendered by Messrs. Babcock and Cooper, and their assistants, in preparing the surveys, maps, etc.

Respectfully submitted.

E. HOWARD CROCKER,
Division Engineer.

ABSTRACT of the character and amount of work required to construct the enlarged canal from the junction of the Erie and Champlain canals, West Troy, to Saratoga bridge.

Quantities.	ITEMS.	Estimated price.	Amounts.
161	Acres land appropriated	\$100 00	\$16, 100 00
10	Buildings to be removed	50 00	500 00
	Temporary damages	5,000 00	5,000 00
1	Grubbing and clearing	5,800 00	5,800 00
1	Bailing and draining	14,500 20	14,500 20
1, 113, 886	Cubic yards excavation of earth	25	278,346 50
38, 742	Cubic yards excavation of solid rock	1 50	58, 113 00
176, 204	Cubic yards excavation of loose rock	1 00	176, 204 00
3, 882	Cubic yards excavation of old masonry	1 00	3, 882 00
202, 541	Cubic yards embankment	20	40,508 00
138, 441	Cubic yards lining	50	69,220 50
13, 000	Cubic yards procuring and puddling	80	10,400 00
114, 634	Cubic yards slope wall	2 50	286,685 00
26, 890	Cubic yards vertical wall in cement	5 00	134,450 00
14, 279	Cubic yards vertical wall, dry	4 00	57,116 00
700	Cubic yards loose stone	1 50	1,050 00
200	Cubic yards loose stone and brush	2 50	500 00
12, 061	Cubic yards masonry, ashlar	8 00	96,648 00
200	Cubic yards masonry, arch	15 00	3,000 00
809	Cubic yards masonry, in coping	15 00	12,135 00
340	Cubic yards masonry, in concrete	5 00	1,700 00
90, 509	Feet B. M. white oak	70 00	6,335 63
49, 983	Feet B. M. hard wood	40 00	1,999 32
468, 687	Feet B. M. pine	50 00	23,431 85
1, 556, 223	Feet B. M. hemlock	25 00	38,905 75
2, 400	Lineal feet piles delivered	12	288 00
2, 400	Lineal feet piles driven	12	288 00
196, 473	Pounds wrought-iron	10	19,647 30
113, 494	Pounds cast-iron	08	9,079 52
10, 700	Pounds spikes and nails	08	856 00
9, 576	Square yards painting	50	4,788 00
142	Rods road	5 00	710 00
5, 635	Lineal feet snubbing posts	70	3,944 50
	Engineering and contingencies	10 per ct.	\$1,882,132 07 138,213 20
	Total		\$1,520,345 27

ABSTRACT of the character and amount of work required to construct the enlarged Champlain canal, from Saratoga bridge to Whitehall.

Quantities.	ITEMS.	Estimated prices.	Amounts.
127	Acres land appropriated	\$100 00	\$12,700 00
50	Buildings to be removed	50	2,500 00
	Temporary damages		10,000 00
1	Grubbing and clearing		3,000 00
1	Bailing and draining		10,000 00
1,183,250	Cubic yards excavation of earth	25	295,812 50
49,150	Cubic yards excavation solid rock	1 50	73,725 00
3,500	Cubic yards excavation loose rock	1 00	3,500 00
5,850	Cubic yards excavation old masonry	1 00	5,850 00
235,250	Cubic yards embankment	20	57,050 00
164,420	Cubic yards lining	50	82,210 00
18,000	Cubic yards procuring and puddling	80	14,400 00
132,690	Cubic yards slope wall	2 50	331,725 00
8,805	Cubic yards vertical wall in cement	5 00	44,025 00
26,785	Cubic yards vertical wall, dry	4 00	107,140 00
700	Cubic yards loose stone	1 50	1,050 00
200	Cubic yards loose stone and brush	2 50	500 00
10,677	Cubic yards masonry, ashlar	8 00	85,416 00
140	Cubic yards masonry, arch	15 00	2,100 00
622	Cubic yards masonry, in coping	15 00	9,330 00
270	Cubic yards masonry, in concrete	5 00	1,350 00
88,700	Feet B. M. white oak	70 00	6,209 00
45,200	Feet B. M. hard wood	40 00	1,808 00
454,000	Feet B. M. pine	50 00	22,700 00
3,453,200	Feet B. M. hemlock	25 00	86,455 00
4,800	Lineal feet piles delivered	12	576 00
4,800	Lineal feet piles driven	12	576 00
172,650	Pounds wrought-iron	10	17,265 00
100,950	Pounds cast-iron	08	8,076 00
8,450	Pounds spikes and nails	08	676 00
8,300	Square yards painting	50	4,150 00
85	Rods road	5 00	425 00
10,000	Lineal feet snubbing posts	70	7,000 00
	Engineering and contingencies	10 per ct.	\$1,209,299 50
	Total		120,929 95
			\$1,330,299 45

There has been on this canal a steady increase of business almost every year over each preceding year.

The amount done would be much greater but for the almost yearly low stage of water in the Hudson river during portions of the season. From three to six weeks of each year the lumber manufactories have been forced to stand still and a large number of operatives thrown out of employment.

The mills have been shut down and the water taken for canal purposes.

The consequence has been an immense decrease in the manufacture of lumber and a consequent loss of that amount of business to the canal. This question has become an important one, not only to the operators and laboring men along the line of the stream, but also to

the State in its loss of trade and tolls. It has been estimated from reliable data that the amount of lumber manufactured on the river within a distance of nine miles between the village of Fort Edward and the Glen's Falls feeder dam was less last year by ninety millions of feet, board measure, than the average of the preceding five years. This trade has all been lost to the Champlain canal, and tolls to the amount of many thousands of dollars lost to the State.

There is a remedy for this, and it should be resorted to at the earliest practicable period.

It is in the construction of reservoirs on the head waters of the Hudson river, where nature in many instances offers marked facilities for such purposes. There are a number of lakes whose outlets could be dammed at a nominal expense, large areas flowed, and vast quantities of water husbanded for use in time of dry weather and need. It is estimated from reliable information that Indian lake alone, whose water shed is about 125,000 acres, could at a small expense be converted into a reservoir that would hold about three thousand millions cubic feet of water, nearly double the capacity of all three of the reservoirs on the head of the Black river. The same might be said of Schroon, Paradox and other lakes.

For a number of years past the Hudson river has been subject to heavy freshets, especially in the spring. The waters from rains and melting snows accumulating from those extensive water-sheds more rapidly than in former years, passes into the main channel, swelling it to vast proportions, the mighty volume rushing onward, imperiling and damaging property to the amount of hundreds of thousands of dollars all the way from its source to the city of Albany. A few weeks elapse, and the water is so low as not only to stop the manufacturing along the stream, but to embarrass navigation on the canals, and especially on the river in the vicinity of Troy and Albany.

A few reservoirs constructed, as suggested, on the head waters of the river, would be of inestimable value in keeping back in the spring, or in times of excessive rains, this vast surplus of water for use whenever needed.

It is to be hoped that the attention of the Legislature will be called to this subject at an early day, and that appropriations will be made to pay the cost of examinations and surveys for these reservoirs.

Some thirty-four of the locks on the Black River canal are in a bad condition. They were originally built of shaky, unsound stone, and their decomposition, together with the disappearance of the mortar

from the joints, render them exceedingly leaky, and the gates very difficult to operate. Something will have to be done to them to remedy this evil. It is possible that by excavating in rear of the chamber walls, from the lower quoins to the head, and carefully grouting, the masonry may be so repaired as to last for a number of years.

It can but be a source of much gratification to the Canal Commissioners and the other members of the Canal Board to revert in future to the success which has attended the navigation of the canals during the past two years, since the abolition of the contract system of repairs and management. Although the business of 1870 was not as great as that in some preceding years, yet the freedom from breaks and disastrous detentions, and the general good management, were such as to restore confidence in canal navigation and bring to them this year, under the same good management, a traffic exceeding thus far that of any year since their construction.

Respectfully submitted.

E. HOWARD CROCKER,
Division Engineer, Eastern Division.

TABLE No. 1.

Showing the number and compensation of Engineers employed on the Eastern Division of the New York State Canals, together with incidental expenses from October 1st, 1870, to September 30th, 1871:

REPAIRS ERIE CANAL.

NAMES.	Rank.	Rate of compensation.	Amount.	Total.
E. H. Crocker...	Division engineer.....	\$2,400 00	\$1,275 00	\$3,175 62
E. H. Crocker.....	Travel.....		366 62	
Peter Hogan.....	Resident engineer.....	2,000 00	1,100 00	
Peter Hogan.....	Travel.....		434 00	
<i>Incidental Expenses.</i>				
	Postage and telegraph.....		\$107 16	444 43
	Stationery.....		164 50	
	Miscellaneous.....		172 77	
Total Erie canal.....				\$3,620 05

REPAIRS CHAMPLAIN CANAL.

E. H. Crocker.....	Division engineer.....	\$2,400 00	\$750 00	\$1,865 14
E. H. Crocker.....	Travel.....		245 14	
Peter Hogan.....	Resident engineer.....	2,000 00	625 00	
Peter Hogan.....	Travel.....		245 00	
<i>Incidental Expenses.</i>				
	Postage and telegraph.....		\$18 59	\$71 54
	Miscellaneous.....		52 95	
Total Champlain canal.....				\$1,936 68

REPAIRS BLACK RIVER CANAL.

E. H. Crocker.....	Division engineer.....	\$2,400 00	\$375 00	\$817 00
E. H. Crocker.....	Travel.....		71 04	
Peter Hogan.....	Resident engineer.....	2,000 00	275 00	
Peter Hogan.....	Travel.....		95 96	
Total Black River canal.....				\$817 00

IMPROVEMENT CHAMPLAIN CANAL.

NAMES.	Rank.	No. of days.	Rate of compensation.	Amount.	Total.
W. B. Cooper.....	Assistant engineer.....	78	\$5 50	\$429 00	\$1,479 50
J. J. McLean.....	Office assistant.....	79	4 00	316 00	
David Evans.....	Office assistant.....	129	3 00	387 00	
G. W. Satterlee.....	Rodman.....	50	3 00	150 00	
G. W. Satterlee.....	Office assistant.....	79	2 50	197 50	97 54
<i>Incidental Expenses.</i>					
	Postage and telegraph.....			\$29 54	
	Office rent.....			37 00	
	Miscellaneous.....			31 00	97 54
Total improvement Champlain.....					\$1,577 04

TABLE No. 1—(Continued).

ENLARGEMENT CHAMPLAIN CANAL.

NAMES.	Rank.	No. of days.	Rate of compensation.	Amount.	Total.
W. B. Cooper	Assistant engineer	129	\$6 00	\$774 00	
S. E. Babcock	Assistant engineer	129	6 00	774 00	
H. K. Averill, Jr.	Assistant engineer	123	5 00	615 00	
R. J. Hilton	Assistant engineer	105	5 00	525 00	
R. J. Hilton	Assistant engineer	74	4 50	333 00	
B. H. Brevoort	Assistant engineer	129	5 00	645 00	
Stephen Thorne	Assistant engineer	129	5 00	645 00	
Isaiah Fuller	Assistant	65	6 00	390 00	
C. W. M. Johnson	Surveyor	67	4 00	268 00	
J. C. Laass	Draughtsman	101	5 00	505 00	
Charles Burrus	Draughtsman	41	5 00	205 00	
W. H. Newkirk	Leveler	129	4 00	516 00	
Edwin Hall	Leveler	129	4 00	516 00	
H. A. Smith	Leveler	42	4 00	168 00	
W. F. Potter	Rodman	55	3 00	165 00	
A. D. Robinson	Rodman	55	3 00	165 00	
N. B. Ward	Rodman	118	3 00	354 00	
J. W. Ingalls	Rodman	5	3 00	15 00	
G. H. Mariner	Chainman	52	2 50	130 00	
C. O. Green	Chainman	55	3 00	165 00	
M. J. Manning	Chainman	118	3 00	354 00	
W. E. Brown	Chainman	67	3 00	201 00	
Thomas O'Connor	Chainman	67	3 00	201 00	
G. C. Squires	Flagman	55	2 50	137 50	
John Pike	Flagman	55	2 50	137 50	
W. H. Hand	Flagman	109	2 50	272 50	
A. H. Holbrook	Flagman	55	2 50	137 50	
O. H. Moore	Axeman	79	2 50	197 50	
Martin Joyce	Axeman	55	2 50	137 50	
Martin Kelley	Axeman	118	2 50	295 00	
John Tate	Axeman	55	2 50	137 50	
G. A. Toole	Tapeman and axeman	118	2 50	295 00	
G. W. Wilson	Tapeman and axeman	55	2 00	110 00	
J. L. Woodin	Tapeman	55	2 00	110 00	
C. D. G. Waters	Tapeman	55	2 00	110 00	
James Langworthy	Tapeman	55	2 00	110 00	
C. H. Sherrill	Tapeman	55	2 00	110 00	
J. S. Robertson	Tapeman	52	2 50	130 00	
C. H. Bishop	Tapeman	55	2 00	110 00	
Leslie Smyth	Office assistant	26	3 50	91 00	
<i>Incidental expenses.</i>					\$11,257 50
Stationery				\$927 67	
Fuel				62 67	
Office rent				50 00	
Light				5 60	
Miscellaneous				2,731 86	
					3,777 80
Total Enlargement					\$15,035 35

SAND LAKE RESERVOIR.

S. E. Babcock	Assistant engineer	30	\$6 00	\$180 00	
R. J. Hilton	Assistant engineer	30	5 00	150 00	
R. J. Hilton	Assistant engineer	53	4 50	238 50	
C. L. Phelps	Assistant engineer	22	5 00	110 00	
M. H. Roberts	Leveler	30	4 50	135 00	
W. S. Lee	Leveler	22	4 00	88 00	
R. J. Kinney	Rodman	30	4 00	120 00	
N. B. Ward	Chainman	22	3 00	66 00	
J. D. Slingerland	Chainman	30	3 00	90 00	
Henry Studer	Axeman	5	2 50	12 50	
Stephen Kavanagh	Axeman	9	2 50	22 00	
Mike O'Hara	Axeman	5	2 50	12 50	
Charles Coudry	Axeman	10	2 50	25 00	
William Skillier	Axeman	11½	2 50	28 75	
William Dolphin	Axeman	2	2 50	5 00	
<i>Incidental expenses.</i>					\$1,283 75
Miscellaneous					211 00
Total					\$1,494 75

TABLE No. 1—(Continued).

EXTRAORDINARY REPAIRS ERIE CANAL.

NAMES.	Rank.	No. of days.	Rate of compensation.	Amount.
John A. Cooper.....	Draughtsman.....	313	\$5 00	\$1,565 00
C. M. Thompson.....	Assistant in office.....	313	5 00	1,565 00
G. F. Oliver.....	Assistant engineer.....	129	5 00	645 00
G. M. Barnes.....	Assistant engineer.....	287	6 00	1,722 00
G. M. Barnes.....	Assistant engineer.....	26	5 00	130 00
R. D. Shepherd.....	Assistant engineer.....	261	5 00	1,305 00
S. E. Babcock.....	Assistant engineer.....	101	5 50	555 50
S. E. Babcock.....	Assistant engineer.....	53	6 00	318 00
M. H. Roberts.....	Draughtsman.....	263	4 00	1,132 00
R. J. Cantwell.....	Assistant engineer.....	10	4 50	45 00
F. J. Harris.....	Rodman.....	112	3 00	336 00
P. J. Kinney.....	Leveler.....	204	4 50	918 00
P. J. Kinney.....	Leveler.....	53	4 00	212 00
W. H. Newkirk.....	Leveler.....	184	4 00	736 00
Jas. M. Ball.....	Rodman.....	202	3 00	606 00
W. S. Lee.....	Leveler.....	178	4 00	712 00
Samuel Moak.....	Leveler.....	261	4 00	1,044 00
Samuel Moak.....	Leveler.....	52	3 50	182 00
J. D. Slingerland.....	Rodman.....	151	2 50	377 50
Leslie Smyth.....	Office assistant.....	73	3 50	255 50
L. L. Lowell.....	Inspector.....	181	4 00	724 00
Stephen Thorne.....	Assistant engineer.....	184	4 50	828 00
Edwin Sears.....	Inspector.....	52	4 00	208 00
Alex. Robertson.....	Inspector.....	191	4 00	764 00
Edward Vaughn.....	Inspector.....	313	4 00	1,252 00
Tunis Cragler.....	Axeman.....	84	2 50	210 00
Garret Vischer.....	Tapeman.....	89	2 50	222 50
Joseph Boyer.....	Inspector.....	102	4 00	408 00
Isaac Thomas.....	Inspector.....	87	4 00	348 00
F. H. Walworth.....	Office assistant.....	105	2 00	210 00
L. L. Nichols.....	Assistant engineer.....	10	8 00	80 00
Horatio Seymour, Jr.....	Tapeman.....	18	3 00	54 00
Total Erie canal.....				\$19,670 00

EXTRAORDINARY REPAIRS CHAMPLAIN CANAL.

Geo. Cushing, Jr.....	Assistant engineer.....	313	\$5 00	\$1,565 00
W. B. Cooper.....	Assistant engineer.....	106	5 50	583 00
R. J. Hilton.....	Assistant engineer.....	51	4 50	229 50
Dana Reed.....	Inspector.....	313	4 00	1,252 00
L. J. Carrington.....	Inspector.....	6	3 50	21 00
John Somers.....	Inspector.....	30	4 00	120 00
Roswell Durkee.....	Inspector.....	36	4 00	144 00
Geo. Dinsmore.....	Inspector.....	28	4 00	112 00
James Dempsey.....	Inspector.....	102	4 00	408 00
F. R. Osborn.....	Inspector.....	46	4 00	184 00
H. A. Smith.....	Inspector.....	103	4 00	408 00
George Dunn.....	Inspector.....	76	5 00	380 00
Total Champlain canal....				\$5,406 50

EXTRAORDINARY REPAIRS BLACK RIVER CANAL.

John A. Allen.....	Assistant engineer.....	79	\$5 00	\$395 00
Total Black River canal....				\$395 00

SUMMARY OF TABLE NO. 1.

NAME OF CANAL.	Engineering proper.	Incidentals.	Amounts.	Totals.
Repairs Erie.....	\$3,175 62	\$444 43	\$3,620 05	\$5,373 73
Repairs Champlain.....	1,895 14	71 54	1,966 68	
Repairs Black River.....	817 00	.....	817 00	
Improvement Champlain.....	1,479 50	97 54	\$1,577 04	18,107 09
Enlargement Champlain.....	1,283 75	211 00	1,494 75	
Sand Lake reservoir.....	11,257 50	3,777 80	15,035 30	
Amount paid by division engineer.....	.....	.....	.....	24,480 82
Extraordinary repairs Erie.....	19,670 00	.....	\$19,670 00	25,471 50
Extraordinary repairs Champlain.....	5,406 50	.....	5,406 50	
Extraordinary repairs Black River.....	395 00	.....	395 00	
Amount paid by Commissioner.....	.....	.....	\$25,471 50	.....
Total for engineering..	.....	.....	.....	\$49,952 32

TABLE No. 2.

STATEMENT showing the length in miles, number of structures, estimated cost at contract prices, amount of work done for the fiscal year ending September 30, 1871, whole amount of work done, and work completed or settled, with the characteristic details of contracts existing upon the Eastern Division of the New York State Canals, for the fiscal year ending September 30, 1871.

Length in miles.	No. of structures.	CHARACTER OF WORK.	Estimated cost at contract prices.	Amount done during fiscal year ending Sept. 30, 1871.	Whole amount done.	Amount remaining to be done.
....	1	EXTRAORDINARY REPAIRS ERIE CANAL. Work let by Canal Commissioners, Laws of 1868. Rebuilding lock No. 2.....	\$30,355 00	\$3,440 00	\$4,280 00	\$26,075 00
....	1	Laws of 1869. Iron side wall and bridge at Cohoes.....	1,401 00	.....	.....	1,401 00
....	1	Sluice at Cohoes guard lock.....	4,274 86	4,274 86	4,274 86	Settled.
....	1	Wooden bridge at Ulton.....	6,440 00	.....	5,240 00	1,200 00
0.30	1	Wall-bench and vertical wall at Ulton.....	13,497 00	.....	11,180 00	2,317 00
....	1	Upper lock at upper side cut, West Troy.....	33,360 00	.....	1,040 00	32,320 00
....	1	Lower lock at upper side cut, West Troy.....	33,635 00	.....	4,080 00	29,555 00
....	1	Removing wall-bench, etc., from Port Schuyler to Lower Mohawk aqueduct.....	185,300 00	3,860 00	185,300 00	Settled.
5.50	....	Removing wall-bench, etc., from locks 43 to 45.....	68,960 00	109,780 00	68,960 00	Settled.
8.75	1	Stone dam across Hudson River at Troy.....	57,140 00	27,240 00	.....	57,140 00
3.25	....	Removing wall-bench, etc., from lower aqueduct to lock No. 30.....	23,405 00	11,440 00	18,540 00	4,865 00
2.75	....	Laws of 1870. Removing wall-bench, etc., from Canajoharie to Fort Plain.....	19,830 00	17,180 00	17,180 00	2,650 00
2.90	....	Removing wall-bench, etc., from locks 40 to 42.....	21,730 00	20,260 00	20,260 00	1,470 00
2.75	....	Removing wall-bench, etc., from locks 41 to 43.....	20,345 00	.....	20,345 00	Settled.
0.21	1	Removing wall-bench, etc., on berme low-path slides at Rome.....	7,580 43	7,580 43	7,580 43	Settled.
....	1	Removing wall-bench, etc., on berme low-path slides at Rome.....	3,849 46	3,849 46	3,849 46	Settled.
....	1	Lowering culvert at Frankfort.....	8,817 76	8,817 76	8,817 76	Settled.
....	1	Cast iron arch truss bridge at Frankfort.....	1,206 50	1,206 50	1,206 50	Settled.
....	1	Cast iron arch truss bridge at Schuylers street, Utica.....	1,587 02	1,587 02	1,587 02	Settled.
....	1	Iron bridge across Big basin, at Utica, and improving Big basin.....	6,602 00	.....	.....	6,602 00
....	1	Stone abutment for bridge one mile above Spraker's Basin.....	1,624 00	.....	.....	1,624 00
....	1	Lengthening Schoharie creek dam.....	28,220 00	28,220 00	28,220 00	Settled.
....	1	Wrought iron low-path bridge at Upper side cut, West Troy.....	4,317 00	.....	.....	4,317 00
0.19	....	Laws of 1871. Constructing 1,000 lineal feet of vert. wall in cement, and grouted, east of guard lock in Utica.....	4,268 00	.....	.....	4,268 00

0.15	.....	Removing wall bench, etc., and constructing 800 lineal ft. vert. wall, in Utica,	\$3,095 00	.....	.....	\$3,095 00
0.20	.....	Removing wall-bench, etc., and constructing 1,100 lineal feet vertical wall at	4,709 00	.....	.....	4,709 00
0.30	.....	Rome.	2,696 00	.....	.....	2,696 00
0.20	.....	Removing wall-bench, etc., from lock 42 to 43	4,807 20	.....	\$4,807 20	Settled.
.....	1	Iron road and tow-path bridge just above lock 18				
		Total under contract	\$594,975 23	\$222,016 23	\$388,876 23	\$206,599 00
0.32	.....	<i>Work done by Canal Commissioners.</i>				
.....	2	Oriskany feeder	\$2,738 71	\$2,738 71	\$2,738 71	
.....	1	Two farm bridges over and ditch adjacent to Rocky Rift feeder	996 91	996 91	996 91	
.....	1	Lengthening west abutment White street bridge, Cohoes	586 48	586 48	586 48	
.....	1	Removing original bottom at Finck's Basin	2,923 19	2,923 19	2,923 19	
.....	1	Improving canal on berme side at head of lock 39	1,379 15	1,379 15	1,379 15	
		<i>Work authorized by Canal Board and done under supervision of Division Engineer and Commissioner in charge.</i>				
.....	1	Utilizing the feed water at lock 37	4,000 00	2,986 00	2,986 00	\$1,014 00
		Total not under contract	\$12,624 44	\$11,610 44	\$11,610 44	\$1,014 00
		Total under and not under contract	\$607,599 67	\$223,626 67	\$389,966 67	\$207,613 00

EXTRAORDINARY REPAIRS — CHAMPLAIN CANAL.

1	Stone dam across the Mohawk at Cohoes (excess over wooden plan).....	\$50,000 00	\$50,000 00	\$50,000 00	
	<i>Work let by Canal Commissioners.</i>				
1	Dredging Whitehall basin.....	34,260 00	10,460 00	34,260 00	
	<i>Laws of 1869.</i>				
1	Glen's Falls feeder lock (excess over old plan).....	10,000 00	10,000 00	10,000 00	
1	Saratoga dam (excess over wooden dam).....	27,000 00	27,000 00	27,000 00	
1	Vertical wall and stop-gate at Fort Edward.....	9,735 10	9,735 10	9,735 10	Settled.
	<i>Laws of 1870.</i>				
1	Flynn's lock, enlarged size (excess over old plan).....	17,000 00	17,000 00	17,000 00	
...	Vertical wall on berme and tow-path slides Glen's Falls feeder at Sandy Hill....	16,680 00	16,680 00	16,680 00	
1	Improvement at Waterford.....	8,200 00	8,200 00	8,200 00	
1	Wrought-iron road and tow-path bridge at Fort Edward.....	7,264 50	7,264 50	7,264 50	
...	Improvement from south end guard lock above Schuylerville to Bullard's Bend, ..	9,740 50	.....	.....	Settled.
	<i>Laws of 1871.</i>				
2	Two locks on enlarged size and section work connected at "Three locks" above Waterford.....	23,530 00	.....	.....	23,530 00
	Total under contract.....	\$213,400 10	\$45,367 60	\$180,139 60	\$38,260 50

TABLE No. 2 — (Continued).

Length in miles.	No. of structures.	CHARACTER OF WORK.	Estimated cost at contract prices.	Amount done during fiscal year ending Sept. 30, 1871.	Whole amount done.	Amount remaining to be done.
<i>Work done by Canal Commissioners.</i>						
....	1	Glen's Falls feeder dam.....	\$25,000 00	\$25,000 00	\$25,000 00	
....	1	Stop gates at mouth of Glen's Falls feeder.....	1,887 74	1,887 74	1,887 74	
		Total not under contract.....	\$26,887 74	\$26,887 74	\$26,887 74	
		Total under and not under contract.....	\$240,287 84	\$173,265 34	\$207,027 84	\$63,260 50
EXTRAORDINARY REPAIRS—BLACK RIVER CANAL.						
<i>Work let by Canal Board, chap. 579, Laws of 1867.</i>						
....	1	Improvement first level at Rome.....	\$6,764 92	\$463 19	\$6,764 92	Settled.
<i>Work let by Canal Commissioners, Laws of 1869.</i>						
....	1	Bridge over Black river at Parker's Landing.....	20,960 00	10,240 00	20,960 00	Settled.
....	1	Bridge over Black River canal at Port Leyden.....	1,105 63	545 63	1,105 63	Settled.
....	1	Iron bridge at Floyd street, Rome.....	6,131 43	3,231 43	6,131 43	Settled.
....	1	Wooden bridge at Thomas street, Rome.....	787 00	.....	.....	\$787 00
<i>Laws of 1870.</i>						
....	1	Iron bridge at Schuyler street, Boonville.....	1,678 00	1,678 00	1,678 00	Settled.
....	1	Iron bridge at Dominick street, Rome.....	1,873 20	1,873 20	1,873 20	Settled.
<i>Laws of 1871.</i>						
....	1	Iron bridge over Black River canal at Boonville.....	915 00	.....	.....	915 00
		Total under contract.....	\$30,215 18	\$18,051 45	\$37,513 18	\$1,702 00
<i>Work done by Canal Commissioners.</i>						
....	1	Inserting cast-iron pipes at Woodhull reservoir.....	\$19,363 18	\$19,363 18	\$19,363 18	
....	1	Constructing Sand Lake reservoir.....	6,505 23	6,505 23	6,505 23	
		Total not under contract.....	\$24,868 41	\$24,868 41	\$24,868 41	
		Total under and not under contract.....	\$64,083 59	\$42,919 86	\$62,381 59	\$1,702 00

TABLE No. 3.

STATEMENT showing amount of work done under supervision of the Engineer Department, on repairs under contract, and on extraordinary and miscellaneous repairs upon the Eastern Division of the New York State canals, for the fiscal year ending September 30th, 1871.

ORDINARY REPAIRS — ERIE CANAL.

Length in miles.	No. of structures.	CHARACTER OF WORK.	Amount remaining to be done.			
			Estimated cost at contract prices.	Amount done during fiscal year ending September 30, 1871.	Whole amount done.	Amount remaining to be done.
....	1	Iron bridge at Fonda st., Schenectady (estimated cost of old plan chargeable).....	\$1,100 00	\$1,100 00	\$1,100 00	Settled.
....	1	Iron bridge at Schuyler st., Utica (estimated cost of old plan chargeable).....	971 00	971 00	971 00	Settled.
....	1	Dredging Albany basin.....	61,065 00	61,065 00	61,065 00	
....		Total.....	\$63,136 00	\$63,136 00	\$63,136 00	
CHAMPLAIN CANAL.						
....	1	Stone dam at Cohoes (chargeable to repairs).....	\$132,980 00	\$66,540 00	\$132,980 00	\$44,294 00
....	1	Saratoga dam (chargeable to repairs as per engineer's estimate).....	46,754 00	2,460 00	2,460 00	Settled.
....	1	Glenn's Falls feeder guard lock (chargeable to repairs).....	23,935 35	1,955 35	23,935 35	Settled.
....	1	Glenn's lock (chargeable to repairs).....	32,540 50	32,540 50	32,540 50	
0.80	2	Two locks on enlarged size and section work connected at "Three locks" above	39,000 00	.....	.....	39,000 00
....	1	Waterford (chargeable to repairs).....	17,148 78	17,148 78	17,148 78	
....	1	Glenn's Falls feeder dam (chargeable to repairs).....	.....	.....	.....
....		Total.....	\$292,358 63	\$120,644 63	\$209,064 63	\$53,294 00
BLACK RIVER CANAL.						
....	1	Iron bridge at Dominick street, Rome (chargeable to repairs).....	\$800 00	\$800 00	\$800 00	Settled.
....	1	Iron bridge at Booneville (chargeable to repairs).....	800 00	.....	.....	\$800 00
....		Total.....	\$1,600 00	\$800 00	\$800 00	\$800 00

SUMMARY OF TABLES NOS. 2 AND 3.

NAME OF CANAL.	Estimated cost at contract prices.	Amount done during fiscal year ending Sept. 30, '71.	Whole amount done.	Am't remain- ing to be done.
Extraordinary repairs Erie.....	\$607,599 67	\$233,626 67	\$399,986 67	\$207,613 00
Extraordinary repairs Champlain..	240,287 84	172,255 34	207,027 34	33,260 50
Extraordinary repairs Black River,	64,083 59	42,919 86	63,281 59	1,702 00
Total.. ..	\$911,971 10	\$448,801 87	\$669,395 60	\$242,575 50
Ordinary repairs Erie.....	\$63,136 00	\$63,136 00	\$63,136 00	
Ordinary repairs Champlain.....	292,358 63	120,644 63	209,064 63	\$83,294 00
Ordinary repairs Black River.....	1,600 00	800 00	800 00	800 00
Total.....	\$357,094 63	\$184,580 63	\$273,000 63	\$84,094 00
Improvement Champlain.....	\$268,620 31	\$53,368 31	\$268,620 31	
Total.....	\$268,620 31	\$53,368 31	\$268,620 31	
Grand total....	\$1,537,686 04	\$686,750 81	\$1,211,016 54	\$326,669 50

*repairs under
"York State*

||

MIDDLE DIVISION.

ANNUAL REPORT OF M. S. KIMBALL, DIVISION ENGINEER, FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1871.

Hon. VAN R. RICHMOND, *State Engineer and Surveyor* :

SIR.—I have the honor to present you the following report :

LENGTH OF COMPLETED CANALS.

	Miles.
Erie canal 68.58, navigable feeders 3.30.....	71.93
Oneida Lake canal and feeder (old).....	7.00
Oswego canal.....	38.00
Oneida river improvement	20.00
Seneca river towing-path	5.75
Baldwinsville canal and improvement to Jack's Reef.....	12.50
Cayuga and Seneca canal.....	22.77
Crooked Lake canal.....	8.00
Chemung canal and feeder.....	39.00
Cayuga inlet.....	2.00
Chenango canal.....	97.00
	<hr/> 323.95 <hr/>

RESERVOIRS AND FEEDERS.

For the Erie Canal.—Erieville reservoir, 340 acres, 21½ feet deep ; De Ruyter reservoir, 656 acres, 18½ feet deep ; Cazenovia lake, 1,778 acres, 4½ feet deep ; Skaneateles lake, 8,320 acres, 7 feet deep ; Otisco lake, 2,200 acres, 10 feet deep ; Owasco lake, 6,800 acres, 2½ feet deep ; and Oneida, Cowasselon, Chittenango, Carpenter Brook, Jordan, Weedsport and Port Byron feeders.

For the Chenango Canal.—Madison Brook reservoir, 235 acres, 45 feet deep ; Bradley Brook reservoir, 134 acres, 25 feet deep ; Eaton Brook reservoir, 254 acres, 50 feet deep ; Hatch's lake, 134 acres, 10 feet deep ; Woodman's pond, 148 acres, 11 feet deep ; Leland's pond, 173 acres, 8 feet deep ; and Kingsley Brook reservoir, 113 acres, 20 feet deep.

ENGINEERING DEPARTMENT.

The Middle Division has been in charge of M. S. Kimball, as Division Engineer, and Howard Soule, Jr., resident.

The following statement shows the total amount of work done during the fiscal year, the total cost of engineering, and the per centage of cost of same:

NAME OF CANAL.	Work done.	Engineering.	Per centage.
Erie	\$132,599 91	\$11,503 88	8.67
Oswego	157,806 13	5,491 85	3.48
Chenango	121,654 83	4,806 76	3.95
Chenango Extension	105,638 92	13,118 03	12.41
Chemung	92,415 01	4,927 68	5.03
Crooked Lake	67,943 63	2,656 61	3.91
Cayuga and Seneca	26,821 68	2,421 50	9.03
Oneida Lake Enlargement	21,280 00	3,689 02	17.33
Total	\$733,162 11	\$48,685 33	6.64

This shows a reduction of \$280,394.87 on work done from last year, also a reduction in engineering expenses of \$6,736.94. The per centage of cost of engineering, however, is raised 1.17, and comes from doing so much less work, while the engineering for it could not be correspondingly reduced.

ERIE CANAL.

There has been \$93,805 done on thirteen old contracts, \$7,252.96 on five old contracts settled, \$860 on two new contracts, and \$1,235.54 on one new contract settled. There remains to complete the thirteen old contracts, \$58,124.50, and the two new, \$20,210. There has also been authorized miscellaneous work done as follows: \$17,362.36 under repair contractors, \$9,011.14 on change of plan, \$1,450.45 by special law, and \$1,622.46 through superintendents, making the total done for the fiscal year, \$132,599.91, and the total remaining of work under contract, \$78,334.50.

Last year I gave some facts relating to the long level, in which it was shown that navigation came near suffering for want of water. Now I have to report, for this year, that the Erieville reservoir was emptied on the first of October, the De Ruyter on the tenth of November, and the Cazenovia practically emptied on the twenty-first of November, there being no reservoir water proper, nothing but the flow of the natural stream. With this state of things, had not the bottoming been done from Syracuse east, as entered upon two winters ago, although not completed, there would have been very

serious detentions to navigation, without any possible means of relieving it temporarily or otherwise. As it was, with the new supply from the Oriskany, the level was uniformly down from four to twelve inches at Syracuse, and graded out, going east almost exactly corresponding with the new made bottom, showing that a supply was needed farther west. I would not only recommend and urge the completion of this bottoming, but urge the extending of it about half a mile farther east, or to the Manlius road crossing, there being deeper water for a long distance beyond. I will not stop here, but urge the immediate construction of a reservoir on the Butternut, above Jamesville, four miles from the canal, which is the nearest practicable point to Syracuse (six miles) in which one can be got. This was estimated to cost, exclusive of land damages in 1869, furnishing 1,102 cubic feet per minute, for sixty days, over the natural flow of the stream, \$78,240. Again, in 1870, raised six feet higher, furnishing 1,989 cubic feet per minute at \$85,000, and a more recent estimate, under a resolution of the Canal Board of August 5th, 1871, with an increased height of banks, but furnishing no more water, at \$91,751, or \$98,018, if built of stone. In my communication to the Canal Board, I said, "Were there no possible doubt about finding a good rock bottom, I should have only presented that report (stone), although it is in excess of the earth one, \$7,000, on the score of less contingency in its future maintenance; as it is, I would recommend the letting of both, and build the one found best adapted to the place."

Chapter 767, Laws of 1870, appropriated \$20,000 for widening locks 47 and 48 at Lodi. Chapter 778, Laws of 1871, reappropriated it to the same object and purpose, to be expended in such manner as the Board of Canal Commissioners shall direct. The locks are to be widened this winter, in the full belief that, although they will be larger than before, yet with the greater ease with which loaded boats will enter, losing nothing from swelling them in as now, that no more water will be used.

This has been fully demonstrated at lock 49, widened some years ago.

OSWEGO CANAL.

There has been \$114,320 done on seven old contracts, \$664.77 on three old contracts, and \$6,563.60 on two new contracts settled. There remains to complete the seven old contracts, \$130,094. There has also been authorized miscellaneous work done as fol-

lows: \$3,917 on change of plans, and \$32,342.76 by special laws, making the total done for the fiscal year \$157,808.13, and the total remaining of work under contract \$130,094.

The high dam was started last spring as soon as the water would allow, and has gone forward uninterruptedly till the water began to rise again this fall. The lockhead and bulkheads at the west end above the mill are completed and the spillway abutment partly built.

The twenty-foot crib work below the old apron, sunk to the rock in twenty feet of water, is in for about 300 feet from the west end and aproned over with whole timber sixty feet long. The finding of rock, and the necessity of founding the new work upon it, will swell the cost, as it adds to the estimate in digging down to it, and again in building up from it. Much has been done all the way in securing the old dam that will form no part of the new dam, but which contributes materially to swell the ultimate cost of it.

The Minetto dam is finished, and although it has been in hand and worked upon every year for four years, all of the difficulties have been surmounted, and it is now a complete and permanent structure, making the seventh of the new system of dams on the river.

CHENANGO CANAL.

There has been \$99,740 done on nine old contracts, \$12,837.42 on three old contracts settled, and \$5,440 on one new contract settled. There is one new contract on which nothing has been done. There remains to complete the nine old contracts \$6,475.50, and the single new one \$1,473. There has also been authorized miscellaneous work done as follows: \$2,057 authorized by Canal Board, and \$1,580.41 through superintendents, making the total done for the fiscal year \$121,654.83, and the total remaining of work under contract \$7,948.50.

Chapter 778, Laws of 1871, appropriates \$15,000 "for removing old and inserting new feed pipes, and building waste-weir and spillway to Madison Brook reservoir." The old discharge was through two nine inch pipes, with one disabled and danger that the other might become so, or the whole break out and go away. The plan now is (on which the work is doing and will be completed this fall), to abandon the old pipes altogether and cover up the entrance, then put in two sixteen-inch pipes in a new location, under thirty-three feet head, which will take most of the water, proving pretty conclusively that the forty-five feet used in the old reports must

relate to the depth of the reservoir, and not to the available depth of water that may be drawn on the number of acres represented.

I apprehend now that all the reservoirs on this canal are given in this way, an error of some importance, as now no very reliable estimate can be made of the quantity of water stored without a measurement. It may never be very important for this canal, but should some of them hereafter become useful as exclusive feeders to the Erie, a knowledge of their capacity would be very necessary. This same thing cannot be said of the reservoirs on the Erie. The depth reported means the available depth of water to be drawn for the number of acres they cover.

Although there were eight locks rebuilt last winter, there are very many more now in equally as bad condition. I still remain of the opinion expressed last year, that many of them can be rewooded, just as the plan of their first construction contemplated they should be, and made to last a like term over again. Because the lining of a composite lock gets off from decay or otherwise and leaks, it does not follow that they must come down and be rebuilt in cement to make them tight again; rewood them properly and all will be well.

Several aqueducts, waste-weirs, culverts and many bridges, are in a deplorable condition for want of thorough overhauling and rebuilding.

CAYUGA AND SENECA CANAL.

There has been \$17,091.50 done on five old contracts settled, and \$8,520 on three new contracts. There remains to complete the three new contracts, \$14,889.10. There has also been authorized miscellaneous work done under special law, \$1,210.18; making the total done for the fiscal year, \$26,821.68, and the total remaining of work under contract, \$14,889.10.

Lock 3 at Seneca Falls, of which some fears were expressed last year, stands very well and may last many years as it is.

Chap. 877, Laws of 1869, reappropriated by chap. 778, Laws of 1871, provided \$5,000 for taking out original material in the bottom of the river near Waterloo. The superintendent of repairs reports much of this material to be rock, which, if it is, will involve coffer damming and pumping to do the work. The work should be done, as, when Seneca lake gets low (as it has this season), it necessitates a reduction in the draft of boats to get over it. Most of the money has been expended on the other work and the appropriation should be increased to take out the rock.

It is in contemplation now to build a new stone dam at Waterloo another year, with waste gates adapted to taking off the high water and prevent the raising of Seneca lake unduly. This at the same time will be a benefit to the canal banks wherever before they have suffered from high water. Five thousand dollars appropriated by chap. 767, Laws of 1870, reappropriated by chap. 778, Laws of 1871 (together with \$10,000 contingent upon not being wanted for its original purpose), has in this way been provided to do the work.

Five hundred dollars was also appropriated by chap. 930, Laws of 1871, to take out original bottom near Free Bridge. This has been done.

The work of protecting the berme bank along Seneca lake is now going on and will be completed this fall.

CHEMUNG CANAL.

There has been \$12,860 done on one old contract, \$10,504.59 on three old contracts settled, and \$2,260 on three new contracts. There remains to complete the one old contract, \$3,715 and the three new, \$10,759.20. There has also been authorized miscellaneous work done as follows: \$5,983.66 by special law, \$64,264.26 by repair contractor as a break account, and \$3,542.50; making the total done for the fiscal year \$99,415.01, and the total remaining of work under contract, \$14,474.20.

Of the break in the dam at Gibson (April 19th, 1870), of which a minute account was given in the report of last year, it is only necessary now to say that it was completed late last fall upon the plan as described in that report, and that it has since remained a perfect structure.

The old style swing bridges at Second, Church, Fifth, Cross and Gray streets, Elmira, all want rebuilding on the Winckler plan. It has been suggested that neither for the purposes of the State, the boating interest or the interest of the people of Elmira, is there any longer any use for the canal upon which these bridges are, that the business that used to be done here has now gone to a new point. If this be true it may be better economy to fill it up to that extent rather than to perpetuate the cost of building and maintaining so many bridges.

CROOKED LAKE CANAL.

There is one new contract, but upon which nothing has been done. It amounts to \$1,691. There has been authorized miscellaneous

work done as follows : \$5,478.91 under special laws, and \$62,464.72 through superintendents, making the total done for the fiscal year \$67,943.63, and the total remaining of work under contract \$1,691.

On the contract for bottoming down the lake level, although let the 28th of March last, the contractor did nothing. The superintendent, however, did some bottoming, and some other work on the level that improved it somewhat, but the whole work wants to be done to provide against the low water of the lake.

There were six locks rebuilt last winter by the Canal Commissioner through the superintendent, included in the above statement, costing \$10,108.57 each. The work was faithfully done, the walls are tight, and altogether present a good specimen of locks built on that plan. There are several others that are bad, but I apprehend many could be rewooded and made comparatively good at much less expense.

ONEIDA LAKE CANAL.

With the small appropriation made last winter, the contractors were unwilling to go on with their work. The completion of the filling of the timber pier at the lake, the building of a road bridge and some other work very necessary to protect that already done, is all that has been secured. The report of last year for completing this canal was \$100,000. I would not state it any less now, for the reason that the waste and decay of materials delivered, the running in of exposed banks and slope walls, and other changes on account of suspending the work, together with the cost of engineering, will quite absorb the appropriation of \$25,000.

CAYUGA INLET.

The amount (\$15,000) appropriated by the Legislature of 1869, for constructing pier and dredging Ithaca inlet at the head of Cayuga lake has been expended and the contract settled.

Chapter 715 of the Laws of 1871 appropriates the further sum of \$12,500 "for finishing the work and improvements at the head of Cayuga lake, to be expended under the direction of the Commissioner in charge."

The work has been let, and is now progressing, contemplating the extension of the pier two hundred feet, and dredging the inlet and harbor to make seven feet depth at lowest water.

EXPLANATION.

Table No. 1 is an exhibit in detail of the cost of engineering for all of the work done on the division during the fiscal year.

Table No. 2 shows the total work under contract, the amount done during the fiscal year, and the work remaining to be done on all the canals and works of the Middle Division.

Table No. 3 shows the amount of authorized work upon miscellaneous repairs under the supervision of the Engineer Department for the fiscal year.

Table No. 4 shows the work not under contract on all the canals and works of the Middle Division.

Respectfully submitted.

M. S. KIMBALL,
Division Engineer Middle Division.

EXTENSION OF THE CHENANGO CANAL.

W. S. KIMBALL, Esq., *Division Engineer :*

In my report for the fiscal year ending September 30, 1870, it is stated that orders had been given to suspend work in the preceding June, owing to the exhaustion of the small appropriation for this canal.

It was continued, however, for a short period on a few of the contracts, where the safety of the work required some additional time and labor.

After the suspension, operations were not again resumed until the following May, and after the appropriation was made by the Legislature of 1871.

In accordance with a provision of the law of last session, all of the expenditures during the past year have been confined to that portion of the canal embraced between the City of Binghamton and Owego. The work below Owego remains as reported in the preceding year.

As the last appropriation was not sufficient to complete all of the work between the points named, including the work through the city of Binghamton, directions were given to prosecute such portions of the canal as, in the unfinished state in which the suspension had left them, would be most liable to injury from the floods and ice of

the Susquehanna, the action of the weather and other causes, and which could be, as far as possible, completed under the appropriation.

It was also thought judicious to have the completed work in a continuous line from the river at Binghamton. A small temporary dam across the canal, near the upper end, now excludes the river during heavy freshets.

With these views work was commenced under the following contracts, namely: Sections numbers two, four, five, six and seven; locks numbers four and six; Choconut, Tracy and Apalachin aqueducts; and culverts on sections numbers one to twenty inclusive.

With the exception of section number two, and locks numbers four and six, on which at this date (December 1) but little remains to be done, all have been completed.

At this date (December 1), and since the close of the fiscal year, much additional work has been done. The Binghamton dam, and section number eighteen, are completed, and the work is progressing on the guard lock and feedway at Binghamton, and on the construction of farm and road bridges over the canal, nine of the latter being now completed.

A review of the work on December first shows that between Binghamton and Owego, twenty-two miles, the canal is completed, except very small portions of sections numbers one and two, and some repairs on sections which were completed several years since.

In the city of Binghamton there remains to complete the connection with that part of the canal in operation, a small portion of section number one, two locks on which some work has already been done, and three railroad bridges.

The guard lock and feedway at the south end of the dam is in progress and could be completed this winter.

A summary of table No. 2, for the fiscal year ending September 30, 1871, embracing all work under contract, or completed between Binghamton and the Pennsylvania State line, is as follows:

Estimated cost at contract prices.....	\$1,986,339 95
Amount done during fiscal year.....	105,638 92
Total amount done.....	1,483,037 01
Amount remaining to be done.....	503,302 94

Work under contract and completed by table No. 2, \$1,986,339 95	
Work not under contract by table No. 4	368,773 00
Total	\$2,355,112 95
Total amount done.....	1,483,037 01
Remaining to be done.....	<u>\$872,075 94</u>

The total amount reported last year of work remaining to be done between Binghamton and the Pennsylvania State line, as per tables Nos. 2 and 4, is, in excess of this year, \$34,331.55.

There has been done during the fiscal year, as stated above, \$105,638.92. This is mainly due to the increase in the aggregate of table No. 4, by the following items, which were not included in last year's report.

Owing to the frequent suspensions of the work, for want of funds and the small annual appropriation, many of the sections that were completed from time to time will now, after from three to five years of exposure and disuse, require repairs more or less extensive, which on the aggregate have been estimated, in table No. 4, at \$33,000. In the city of Binghamton the canal is crossed by several lines of railroads, requiring bridges, the aggregate cost of which is estimated at \$45,000. Farm and road bridges, which at the close of the fiscal year were not under contract, are reported in table No. 4 at \$47,000. This increases the aggregate of table No. 4, \$125,000.

The items in table No. 2 have in some cases been increased and in others decreased over last year, the difference showing a net increase of about \$15,000. This was occasioned in some cases by the damage caused by floods, and the additional precautionary measures deemed advisable to guard against further injury to the works. It was also found necessary as the work progressed to remove more earth from the slopes in some of the heavier cuts in order to keep the canal open.

Additional lining was also necessary, and a retaining wall to prevent the sliding of a portion of one of the streets of Binghamton into the canal.

Table number 1 exhibits the engineer and incidental expenses, and amounts to \$13,118.03, or $12\frac{41}{100}$ per cent of the work done during the fiscal year.

By resolution of the Canal Board after the suspension in June (passed in July and August) it became necessary to ascertain the

amount of the per centage retained by the State on the several contracts. This work, which required careful and exact measurements on all of the contracts between Binghamton and Owego, and below the latter point, which had been under prosecution, prevented as large a reduction of the engineer force as would otherwise have occurred; and as the contract work had stopped, the per centage of engineering expenses for the entire year to the other work was obviously increased.

It will be observed in comparison with the amount reported in the previous year that the cost of engineering is reduced $44\frac{1}{2}$ per cent.

In closing I would state, as in my last report, that the loss incurred by depreciation and damage to the works during their suspension for want of funds; the importance of a speedy completion in order to connect with the coal fields of Pennsylvania, and reduce the cost of transportation on coal; the large amount of work already done; the comparatively small cost to finish the canal; and the loss of interest or earnings on the amounts already expended, are urged as strong reasons for a sufficient appropriation at the approaching session of the Legislature to speedily complete the remaining work, and particularly to bring into use that portion, now so nearly finished, comprised in the first thirty miles.

Very respectfully,

C. L. McALPINE,
Resident Engineer.

TABLE No. 1.

STATEMENT of Engineering upon Repairs of Middle Division of New York State Canals, together with Incidental Expenses for the Fiscal Year ending September 30th, 1871.

ERIE CANAL.

NAME.	Rank.	No. of days.	Rate of compensation.	Amount.	Totals.
M. S. Kimball	Division engineer	Salary.	\$2,400 00	\$600 00	\$1,725 00
M. S. Kimball	Division engineer	Travel.		210 00	
Howard Soule, Jr.	Resident engineer	Salary.	2,000 00	725 00	
Howard Soule, Jr.	Resident engineer	Travel.		190 00	
<i>Incidental Expenses.</i>					
Stationery				\$200 91	
Postage, telegr'h & express				262 32	
Fuel and light				61 25	
Miscellaneous				250 40	
					764 88
Total for Erie canal					\$2,489 88

CAYUGA AND SENECA CANAL.

M. S. Kimball	Division engineer	Salary.	\$2,400 00	\$155 00	\$624 00
M. S. Kimball	Division engineer	Travel.		75 00	
Howard Soule, Jr.	Resident engineer	Salary.	2,000 00	300 00	
Howard Soule, Jr.	Resident engineer	Travel.		94 00	
Total for Cay. & Sen. can'l					\$624 00

CROOKED LAKE CANAL.

M. S. Kimball	Division engineer	Salary.	\$2,400 00	\$200 00	\$394 00
M. S. Kimball	Division engineer	Travel.		67 00	
Howard Soule, Jr.	Resident engineer	Salary.	2,000 00	100 00	
Howard Soule, Jr.	Resident engineer	Travel.		27 00	
<i>Incidental Expenses.</i>					
Stationery				\$14 61	
					14 61
Total for Crooked Lake c'l					\$408 61

CHEMUNG CANAL.

M. S. Kimball	Division engineer	Salary.	\$2,400 00	\$425 00	\$1,036 00
M. S. Kimball	Division engineer	Travel.		162 00	
Howard Soule, Jr.	Resident engineer	Salary.	2,000 00	350 00	
Howard Soule, Jr.	Resident engineer	Travel.		99 00	
<i>Incidental Expenses.</i>					
Stationery				\$25 14	
Postage, telegr'h & express				19 54	
					54 68
Total for Chemung canal					\$1,090 68

TABLE No. 1—(Continued).

OSWEGO CANAL.

NAME.	Rank.	No. of days.	Rate of compensation.	Amount.	Totals.
M. S. Kimball.....	Division engineer.....	Salary.	\$2,400 00	\$845 00	
M. S. Kimball.....	Division engineer.....	Travel.		348 96	
Howard Soule, Jr.....	Resident engineer.....	Salary.	2,000 00	195 00	
Howard Soule, Jr.....	Resident engineer.....	Travel.		61 32	
	<i>Incidental Expenses.</i>				\$1,450 28
	Stationery.....			\$18 10	
	Postage, tel. and express..			23 87	
	Fuel and light.....			6 60	
	Miscellaneous.....			25 00	
					78 57
	Total for Oswego canal..				\$1,528 85

CHENANGO CANAL.

M. S. Kimball.....	Division engineer.....	Salary.	\$2,400 00	\$175 00	
M. S. Kimball.....	Division engineer.....	Travel.		80 00	
Howard Soule, Jr.....	Resident engineer.....	Salary.	2,000 00	330 00	
Howard Soule, Jr.....	Resident engineer.....	Travel.		90 00	
	<i>Incidental Expenses.</i>				\$675 00
	Stationery.....			\$42 86	
	Postage, tel. and express..			10 90	
					53 76
	Total for Chenango canal				\$738 76
	Total repairs mid. div'n.				\$6,870 78

TABLE No. 1—(Continued).

STATEMENT of Assistants employed upon Ordinary and Extraordinary Repairs during the Fiscal Year ending September 30th, 1871, and paid by Canal Commissioner, under act, chapter 447, Laws of 1865.

NAME.	Canal.	No. of days.	Rate of compensation.	Amount.	Totals.
Denison Richmond.....	Erie	313	\$5 00	\$1,565 00	\$7,914 00
W. D. Dunning.....	Erie	20	5 00	100 00	
M. J. Dolphin.....	Erie	313	5 00	1,565 00	
J. V. Norton.....	Erie	93	5 00	465 00	
E. L. Luddington.....	Erie	79	4 50	355 50	
E. L. Luddington.....	Erie	234	4 00	936 00	
George S. Field.....	Erie	65	4 50	292 50	
Barney Becker.....	Erie	157	4 00	628 00	
Alexander Everts.....	Erie	140	4 00	560 00	
C. R. Breed.....	Erie	105	4 00	420 00	
J. V. Norton.....	Erie	230	4 00	880 00	
A. V. Meeker.....	Erie	43	3 50	147 00	
B. J. Kimball.....	Oswego.....	79	4 00	\$316 00	
C. E. Smith.....	Oswego.....	234	4 00	936 00	
Joseph Wilbur.....	Oswego.....	166	3 50	581 00	
Isaac Thorp.....	Oswego.....	158	3 00	474 00	
O. R. Breed.....	Oswego.....	129	4 00	516 00	
H. H. Coats.....	Oswego.....	236	4 50	1,062 00	
George Briggs.....	Oswego.....	26	3 00	78 00	
D. E. Whitford.....	Chemung and Crooked Lake	313	5 00	\$1,565 00	3,963 00
Calvin Shelton.....	Chemung and Crooked Lake	313	4 00	1,252 00	
H. T. Beach.....	Chemung and Crooked Lake	234	4 00	936 00	
H. R. Wright.....	Chemung and Crooked Lake	26	3 00	78 00	
O. H. Wright.....	Chemung and Crooked Lake	79	3 00	237 00	
H. R. Wright.....	Chemung and Crooked Lake	44	4 00	176 00	
George E. Runyan.....	Chemung and Crooked Lake	63	4 00	252 00	
John T. Herrick.....	Cayuga and Seneca.....	254	5 00	\$1,270 00	
H. T. Beach.....	Cayuga and Seneca.....	79	4 00	316 00	
L. H. Hopkins.....	Cayuga and Seneca.....	47	4 50	211 50	
Wm. V. Van Rensselaer	Chenango.....	313	5 00	\$1,565 00	1,797 50
Charles A. Beach.....	Chenango.....	100	5 00	500 00	
Charles D. Smith.....	Chenango.....	115	3 00	345 00	
J. W. Clark.....	Chenango.....	153	4 00	612 00	
Warren Post.....	Chenango.....	69	4 00	276 00	
H. M. Race.....	Chenango.....	175	4 00	700 00	
A. J. Hackley.....	Chenango.....	20	4 00	80 00	
H. R. Wright.....	Chemung.....	79	3 00	\$237 00	
O. H. Wright.....	Chemung.....	155	3 00	465 00	
D. P. Dey.....	Chemung.....	158	4 00	632 00	
George E. Runyan.....	Chemung.....	49	4 00	196 00	4,078 00
Peter B. Russell.....	Chemung.....	43	3 00	129 00	
Total.....	\$23,907 50

TABLE No. 1 — (Continued).

STATEMENT of Engineering upon Construction of Oneida Lake Canal, together with Incidental Expenses, for the Fiscal Year ending September 30th, 1871.

NAME.	Rank.	No. of days.	Rate of compensation.	Amount.	Totals.
H. D. Brockway	Leveler.....	313	\$4 50	\$1,408 50	
F. G. Kelsey	Rodman	313	3 50	1,095 50	
Simon L. Briggs	Axman	313	2 50	782 50	
H. C. Lower	Inspector.....	79	3 50	276 50	
	<i>Incidental Expenses.</i>				\$3,563 00
	Stationery.....			\$34.78	
	Postage and telegraph.....			9.67	
	Office rent, fuel and light.....			80.82	
	Miscellaneous			75	
					126 02
	Total for On. Lake canal				\$3,689 02

TABLE No. 1 — (Continued).

STATEMENT of Engineering upon Construction of Otisco Lake Reservoir, for the Fiscal Year ending September 30th, 1871.

NAME.	Rank.	No. of days.	Rate of compensation.	Amount.	Total.
Charles A. Sweet	Assistant engineer	220	\$5 00	\$1,100	\$1,100 00
	Total for Otisco Lake res.				\$1,100 00

TABLE No. 1—(Continued).

STATEMENT of Engineering and Incidental Expenses upon the Extension of the Chenango Canal, for the Fiscal Year ending September 30th, 1871, as authorized by act, chapter 185, Laws of 1864.

NAME.	Rank.	No. of days.	Rate of compensation.	Amount.	Totals.
C. L. McAlpine	Resident engineer	Salary.	\$2,000 00	\$2,000 00	
C. L. McAlpine	Resident engineer	Travel.		417 90	
O. F. Whitford	Assistant engineer	313	5 50	1,721 50	
T. Goodsell	Assistant engineer	102	5 50	561 00	
C. A. Beach	Assistant engineer	26	5 50	143 00	
J. B. Killaly	Draftsman	156	4 50	702 00	
J. B. Killaly	Assistant and draftsman	157	5 00	785 00	
F. Leach, Jr.	Leveler	313	4 50	1,408 50	
G. S. Field	Leveler	30	4 50	135 00	
T. J. Bristol	Tapeman	156	3 25	507 00	
T. J. Bristol	Rodman	157	4 00	628 00	
F. Farrington	Tapeman	102	3 25	331 50	
J. B. Thorn	Flagman	153	2 75	420 75	
J. B. Thorn	Tapeman	157	3 25	510 25	
J. W. Clark	Tapeman	14	3 25	45 50	
J. W. Clark	Rodman	79	4 00	316 00	
L. L. Johnson	Axman	138	2 50	345 00	
J. Hanrahan	Axman	6	2 50	15 00	
H. Odell	Inspector	105	4 00	420 00	
C. H. Sweet	Inspector	105	4 00	420 00	
G. H. Sawyer	Inspector	52	4 00	208 00	
R. Botts	Inspector	72	3 00	216 00	
J. H. Decker	Superintendent of work	18	5 00	90 00	
					\$12,346 90
<i>Incidental Expenses.</i>					
Labor				\$35 75	
Stationery				122 12	
Fuel				82 18	
Light				50 80	
Office rent				354 00	
Postage and telegraph				71 04	
Miscellaneous				55 24	
					771 13
Total Chenango canal ex.					\$13,118 03

SUMMARY OF TABLE No. 1.

Engineering proper for the whole division	\$5,870 78
Engineering for repairs, ordinary and extraordinary	23,907 50
Engineering for the construction of the Oneida Lake canal	3,689 02
Engineering for the construction of Otisco Lake reservoir ...	1,100 00
Engineering for the Chenango canal extension	13,118 08
	<u>\$43,685 38</u>

TABLE No. 2.
STATEMENT of Work under Contract upon the Middle Division of the New York State Canals, for the Fiscal Year ending September 30, 1871.
 ERIE CANAL.

CHARACTER OF WORK.	Appropriation.	When let.	When to be completed.	Engineer's estimate.	Estimated cost at contract prices.	Amount done dur'g fiscal year.	Total amt' done.	Amount remaining to be done.	Remarks.
Otisco Lake reservoir	\$42,000	Oct. 1, 1868	April 30, 1869	\$42,000 00	\$42,000 00	\$700 00	\$41,640 00	\$1,360 00	
Improvement Owaseo Lake outlet	17,500	July 22, 1868	Jan. 1, 1869	21,500 00	18,400 45	2,561 45	16,461 45	Settled	
Rebuilding berm bank near lock No. 50	10,000	July 14, 1868	Dec. 1, 1868	10,000 00	8,225 00	4,850 00	6,125 00	2,900 00	
Filling packet boat basin at Syracuse	3,000	July 14, 1868	Dec. 1, 1868	3,000 00	3,000 00	1,340 00	2,400 00	600 00	
Rebuilding highway, etc., at De Kay-ter reservoir	9,000	July 14, 1868	Dec. 1, 1868	9,000 00	8,425 00	3,320 00	7,380 00	1,045 00	
Rebuilding iron b'gs at Warren st., Syracuse	20,000	July 14, 1868	Dec. 1, 1868	20,000 00	18,925 00	10,600 00	16,125 00	2,800 00	
Rebuilding Chittenango creek channel	7,000	July 14, 1868	Dec. 1, 1868	7,000 00	8,660 00	1,660 00	8,660 00	.....
Remov. waste weir at Covington dam	.....	.....	.....	.....	.....	.....	.....	.....	Belongs to repair contract.
Remov. wall-benches on Jordan level	78,925	April 7, 1870	April 7, 1871	78,925 00	78,925 00	55,065 00	76,380 00	2,115 00	Belongs to repair contract.
Remov. wall-benches on Sycamore level	30,000	July 14, 1868	April 1, 1870	30,000 00	30,000 00	12,140 00	23,440 00	13,560 00	Contract of Canal Com'r.
Remov. wall-benches on Long level	28,000	July 14, 1868	April 1, 1870	28,000 00	28,000 00	.....	14,640 00	13,360 00	
Rebuilding culvert near Burdick's bridge	3,600	Sept. 23, 1868	April 1, 1870	3,600 00	3,380 82	360 82	3,380 82	Settled.	
Well and receiver at discharge weigh-lock sewer	11,000	Sept. 23, 1868	April 1, 1870	11,000 00	11,000 00	.....	.....	11,000 00	Contract not perfected.
Bottoming down east of lock No. 47	45,000	.....	.....	.....	.....	.....	.....	.....	Given to repair contractor act chap. 877, Laws of 1869.
Inserting iron needle beams in bridge at Chittenango	1,420	Aug. 3, 1870	Sept. 1, 1870	1,420 00	1,078 53	1,078 53	1,078 53	Settled.	
Rebuilding of iron, tumpike bridge over feeder at Onville	1,560	Aug. 3, 1870	Nov. 1, 1870	1,560 00	1,172 90	1,172 90	1,172 90	Settled.	
Inserting iron needle beams in bridge Centreport	1,500	Aug. 3, 1870	Sept. 1, 1870	1,500 00	1,079 26	1,079 26	1,079 26	Settled.	
Slope wall on towing-path side Nine Mile Creek feeder	6,000	Aug. 3, 1870	May 1, 1871	6,000 00	3,397 50	320 00	320 00	3,077 50	
Overfall and paved waste at outlet, De Kay's reservoir	12,742	Aug. 3, 1870	Nov. 1, 1870	11,500 00	6,143 00	.....	.....	6,143 00	
Raising Geddes road at Syracuse	22,500	Aug. 3, 1870	Nov. 1, 1870	22,500 00	17,616 00	4,360 00	4,360 00	13,256 00	
Bridges on repair section No. 9	1,900	June 18, 1871	Oct. 1, 1871	1,900 00	1,800 00	860 00	860 00	30 00	
Vertical wall at Caykiddale	1,500	Jan. 23, 1871	April 23, 1871	1,500 00	1,235 54	1,235 54	1,235 54	Settled.	Contract of Canal Com'r.
Remov g wall-benches & subettling slope or vertical wall on Long level	.....	Jan. 23, 1871	April 23, 1871	30,000 00	20,180 00	.....	.....	20,180 00	
Total	.....	.....	.....	\$841,975 00	\$311,603 00	\$103,163 50	\$383,368 50	\$78,384 50	

TABLE No. 2 — (Continued).
OSWEGO CANAL.

CHARACTER OF WORK.	Appropri- ation.	When let.	When to be completed.	Engineer's estimate.	Estimated cost at contract prices.	Amount done dur'g fiscal year.	Total am't done.	Amount remaining to be done.	Remarks.
Stone dam at Minetto, Oswego river.	\$106,100	Nov. 14, 1866	Dec. 1, 1867	\$106,100 00	\$90,000 00	\$24,640 00	\$83,140 00	\$6,860 00	Inc'd by Canal B'd \$11,700.
High dam, Oswego river.	72,000	July 14, 1869	Nov. 1, 1870	160,000 00	130,000 00	53,640 00	66,200 00	63,800 00	
Bulkhead at Farwell's mill.	4,000	July 14, 1869	April 1, 1870	4,000 00	3,756 35	3,395 35	3,756 35	Settled.	
Deepening Oswego river at Oswego.	40,000	July 14, 1869	April 1, 1869	41,500 00	36,600 00	.....	.....	36,600 00	
Vertical wall on enlargement sec. No. 4	4,000	July 14, 1869	April 1, 1870	4,000 00	4,500 00	.....	4,440 00	60 00	
Raising banks, etc., of Oswego canal.	46,000	July 14, 1869	Dec. 1, 1869	46,000 00	38,570 00	13,020 00	25,180 00	13,390 00	
Reb'ling docks on side cuts at Salina	25,000	July 14, 1869	Dec. 1, 1869	25,000 00	19,750 00	7,840 00	17,240 00	2,510 00	
Iron bridge at Division st., Syracuse.	3,400	July 27, 1869	Dec. 1, 1869	3,400 00	3,449 52	.....	3,449 52	Settled.	
Iron bridge at Bear st., Syracuse.	3,325	Aug. 3, 1870	Sept. 1, 1870	.....	.....	.....	.....	.....	Belongs to repair contract.
I'n b'ge at Durston's dry d'k, Syracuse.	600	Aug. 3, 1870	Sept. 1, 1870	.....	.....	.....	.....	.....	Belongs to repair contract.
Iron foot-bridge at Lodi st., Salina.	2,300	Aug. 3, 1870	Sept. 1, 1870	.....	.....	.....	.....	.....	Belongs to repair contract.
Iron bridge at Cold Spring.	7,000	July 14, 1869	Dec. 1, 1869	7,000 00	4,948 42	.....	4,948 42	Settled.	
Culvert near Haskin's salt block be- low Salina.	21,620	Feb. 4, 1870	April 1, 1870	21,620 00	22,174 00	14,520 00	15,300 00	6,874 00	
Iron bridge at Park street, Salina.	4,400	Jan. 28, 1871	April 25, 1871	4,400 00	4,890 35	4,890 35	4,890 35	Settled.	
Iron bridge at Mud lock.	2,630	Jan. 28, 1871	April 25, 1871	2,630 00	1,673 25	1,673 25	1,673 25	Settled.	
Total.	.....	.....	.....	\$425,650 00	\$263,311 89	\$121,548 37	\$230,217 89	\$130,094 00	

CHENANGO CANAL.									
Reb'ling lock No. 105 changed to 110.	.....	Oct. 16, 1865	April 1, 1866	\$13,272 00	\$13,272 00	\$12,790 00	\$12,790 00	\$402 00	
Reb'ling lock No. 106 changed to 101.	.....	Oct. 16, 1865	April 1, 1866	15,382 00	15,382 00	14,180 00	14,180 00	1,202 00	
Rebuilding lock No. 107.	.....	Oct. 16, 1865	April 1, 1866	15,203 00	15,203 00	15,120 00	15,120 00	83 00	
Iron bridge at Genesee st., Greene	\$5,000	Sept. 23, 1869	April 1, 1870	5,000 00	8,884 50	.....	.....	8,884 50	Not built.
Swag bridge at Main (Genesee) st., Greene.	.....	Sept. 1, 1870	Not dated	.....	.....	.....	.....	.....
Swag bridge at Henry st., Binghamton	8,000	July 6, 1870	Sept. 15, 1870	8,000 00	9,543 00	2,543 00	2,543 00	Settled.	Contract of Canal Comm'r.
Rebuilding lock No. 108	8,000	Aug. 10, 1870	Nov. 1, 1870	8,000 00	8,296 17	1,998 25	1,998 25	Settled.	Contract of Canal Comm'r.
Rebuilding lock No. 118	.....	Dec. 16, 1870	April 1, 1871	10,995 00	10,995 00	8,296 17	8,296 17	Settled.	
Rebuilding lock No. 21	.....	Nov. 26, 1870	May 1, 1871	10,480 00	10,480 00	10,760 00	10,760 00	166 00	Contract of Canal Comm'r.
Rebuilding lock No. 47	.....	Nov. 26, 1870	May 1, 1871	13,090 00	13,090 00	10,490 00	10,490 00	.....	Contract of Superintendent.
Rebuilding lock No. 51	.....	Nov. 26, 1870	May 1, 1871	11,695 00	11,695 00	12,760 00	12,760 00	970 00	Contract of Superintendent.
Rebuilding lock No. 51	.....	Nov. 26, 1870	May 1, 1871	12,383 00	12,383 00	11,560 00	11,560 00	195 00	Contract of Superintendent.
Repair & waste-weir repair sec. No. 1.	.....	Mar. 12, 1871	May 1, 1871	12,383 00	12,383 00	12,160 00	12,160 00	193 00	Contract of Superintendent.
Iron bridge at Bouckville.	2,150	July 6, 1871	Sept. 1, 1871	2,150 00	2,443 00	5,440 00	5,440 00	Settled.	
Total.	.....	.....	.....	\$127,464 00	\$128,965 92	\$118,017 42	\$118,017 42	\$7,948 50	

CAYUGA AND SENECA CANAL.

Rebuilding locks Nos. 2, 3, 9, 11	\$27,000	July 14, 1869	April 1, 1870	\$37,000 00	\$31,882 53	\$1,932 53	\$31,882 53	Settled.
Cleaning channel, etc., at Cayuga	15,000	Sept. 23, 1869	Sept. 1, 1870	12,000 00	11,050 84	7,770 84	11,050 84	Settled.
Inlet at Ithaca	7,060	Sept. 23, 1869	April 1, 1870	5,800 00	6,540 51	1,560 51	6,540 51	Settled.
Iron bridge at Ovid st. Seneca Falls ..	2,070	March 8, 1870	April 15, 1870	2,070 00	1,451 17	1,191 17	1,451 17	Settled.
Protecting berme bank along shore	10,000	Aug. 4, 1871	Nov. 1, 1871	9,000 00	9,000 00	6,960 00	6,960 00	\$2,040 00
Seneca lake	2,500	July 6, 1871	Sept. 1, 1871	2,500 00	1,809 10	1,560 00	1,560 00	249 10
Iron needle beams in bridge at Seneca	5,600	Nov. 25, 1870	May 1, 1871	5,600 00	5,586 45	5,586 45	5,586 45	Settled.
Vertical wall at Seneca Falls	12,500	July 6, 1871	Nov. 1, 1871	12,500 00	12,600 00	.....	.....	12,600 00
Extending pier 200 feet and dredging	.....	.....	.....	\$86,470 00	\$79,920 60	\$25,611 50	\$65,081 50	\$14,889 10
harbor at Ithaca .....	.....	.....	.....	.....	.....	.....	.....	.....
Total .....	.....	.....	.....	.....	.....	.....	.....	.....

CHEMUNG CANAL.

Dredging from lock No. 1 to Seneca	\$15,000	Sept. 28, 1869	Sept. 1, 1870	\$15,300 00	\$10,732 21	\$5,632 21	\$10,732 21	Settled.
lake	4,700	July 14, 1869	Dec. 1, 1869	4,700 00	4,357 90	847 90	4,357 90	Settled.
Cleaning out State ditch on farm of	20,000	Aug. 2, 1870	Nov. 1, 1870	20,000 00	16,575 00	12,860 00	12,860 00	\$3,715 00
M. Sayre & Co.	7,000	Aug. 2, 1870	Nov. 1, 1870	7,000 00	4,024 48	4,024 48	4,024 48	Settled.
Raising and extending breakwater at	2,000	June 19, 1871	Sept. 1, 1871	2,000 00	2,260 00	2,260 00	2,260 00	20 00
Watkins	15,000	July 25, 1871	Dec. 1, 1871	15,000 00	9,259 20	.....	.....	9,259 20
Taking up old lock and constructing	2,000	June 19, 1871	Oct. 1, 1871	2,000 00	1,480 00	.....	.....	1,480 00
culvert, etc., at Elmira .....	.....	.....	.....	\$66,000 00	\$48,718 79	\$25,694 59	\$34,244 59	\$14,474 20
Bridge abutments at Watkins .....	.....	.....	.....	.....	.....	.....	.....	.....
Extending breakwater and dredging	.....	.....	.....	.....	.....	.....	.....	.....
harbor at Watkins .....	.....	.....	.....	.....	.....	.....	.....	.....
Iron bridge at Havana .....	.....	.....	.....	.....	.....	.....	.....	.....
Total .....	.....	.....	.....	.....	.....	.....	.....	.....

CROOKED LAKE CANAL.

Bottoming canal level at Penn Yan ..	\$2,000	Mar. 28, 1871	April 25, 1871	\$2,000 00	\$1,691 00	.....	.....	\$1,691 00
Total .....	.....	.....	.....	\$2,000 00	\$1,691 00	.....	.....	\$1,691 00

TABLE No. 2—(Continued).

STATEMENT showing Engineer's Estimate, Estimated Cost at Contract Prices, Estimated Cost at Prices fixed under Laws of 1869 and 1870, Amount Done and Remaining to be Done, and Amount Done during Fiscal Year ending September 30th, 1871.

ONEIDA LAKE CANAL.

CHARACTER OF WORK.	Amount appropriated.	When let.	When to be completed.	Engineer's estimate.	Estimated cost at old contract prices from original titles.	Estimated cost at old contract prices from present titles.	Estimated cost at prices fixed by Board of Canal Commissioners under Laws of '69 & '70.	Amount done during fiscal year.	Total amount done.	Amount remaining to be done.
Section No. 1	\$371,153 47	Dec. 18, 1867	July 1, 1869	.....	\$32,500 00	\$37,000 00	\$50,000 00	.....	\$37,960 00	\$13,040 00
Section No. 2		Dec. 18, 1867	July 1, 1869	.....	46,000 00	53,000 00	65,000 00	.....	65,000 00	90,560 00
Section No. 3		Dec. 18, 1867	July 1, 1869	\$306,000 00	56,000 00	64,000 00	74,000 00	1,940 00	53,440 00	16,400 00
Section No. 4		Dec. 18, 1867	July 1, 1869	.....	55,500 00	66,000 00	86,000 00	1,900 00	79,600 00	14,960 00
Section No. 5		Dec. 18, 1867	July 1, 1869	.....	68,000 00	94,000 00	133,000 00	14,740 00	113,040 00	.....
Total .....	.....	.....	.....	.....	\$358,000 00	\$314,000 00	\$416,000 00	\$31,980 00	\$352,040 00	\$63,960 00

TABLE No. 2 — (Continued).
EXTENSION OF THE CHENANGO CANAL

Length in chains.	CHARACTER OF WORK.	Appropriation.	When let.	When to be completed.	Engineer's estimate.	Estimated cost at contract prices.	Am't done during fiscal year.	Total amount done.	Amount remaining to be done.	Remarks.
68	Section No. 1.	.....	June 23, 1865.	Sept. 1, 1866.	\$7,878 80	\$7,878 80	.....	\$7,878 80	.....	Canceled Oct. 1867.
69	Section No. 2.	.....	July 20, 1866.	April 1, 1870.	14,600 00	11,711 98	.....	11,711 98	.....	Completed.
70	River bank or T. path section.	.....	July 14, 1869.	Nov. 1, 1870.	9,318 81	9,318 81	\$456 81	.....	.....	Completed.
71	Section No. 3.	.....	June 23, 1865.	Sept. 1, 1866.	29,086 87	29,086 87	.....	29,086 87	.....	Canceled Oct. 1867.
72	Section No. 4.	.....	July 20, 1866.	April 1, 1870.	63,000 00	63,274 60	.....	63,274 60	\$12,032 16	Relief.
73	Section No. 5.	.....	June 23, 1865.	Sept. 1, 1866.	30,385 72	30,385 72	8,432 44	.....	.....	Can. Nov. 1869 & at sec.
74	Section No. 6.	.....	July 20, 1866.	April 1, 1870.	6,020 80	6,020 80	.....	6,020 80	.....	Canceled Oct. 1867.
75	Section No. 7.	.....	July 20, 1866.	Sept. 1, 1866.	40,523 61	40,523 61	.....	40,523 61	.....	Relief.
76	Section No. 8.	.....	July 20, 1866.	April 1, 1870.	100,000 00	99,994 72	29,143 72	.....	8,491 00	Canceled Oct. 1867.
77	Section No. 9.	.....	July 20, 1866.	Sept. 1, 1866.	57,435 02	57,435 02	.....	57,435 02	.....	Relief.
78	Section No. 10.	.....	July 20, 1866.	April 1, 1870.	89,900 00	89,100 36	2,915 36	.....	8,960 00	Canceled Oct. 1867.
79	Section No. 11.	.....	July 20, 1866.	Sept. 1, 1866.	89,227 81	89,227 81	.....	89,227 81	.....	Relief.
80	Section No. 12.	.....	July 20, 1866.	April 1, 1870.	45,880 00	45,880 00	.....	45,880 00	.....	Canceled Oct. 1867.
81	Section No. 13.	.....	July 14, 1869.	Nov. 1, 1870.	10,539 80	10,539 80	.....	10,539 80	.....	Canceled June, 1869.
82	Section No. 14.	.....	June 23, 1865.	Sept. 1, 1866.	43,036 00	43,036 00	.....	43,036 00	.....	Completed.
83	Section No. 15.	.....	June 23, 1865.	Sept. 1, 1866.	91,185 00	91,185 00	.....	91,185 00	.....	Completed.
84	Section No. 16.	.....	June 23, 1865.	Sept. 1, 1866.	19,745 00	19,745 00	.....	19,745 00	.....	Completed.
85	Section No. 17.	.....	June 23, 1865.	Sept. 1, 1866.	6,639 62	6,639 62	.....	6,639 62	.....	Canceled Oct. 1867.
86	Section No. 18.	.....	July 20, 1866.	April 1, 1870.	13,100 00	13,100 00	.....	13,100 00	.....	Completed.
87	Section No. 19.	.....	Feb. 7, 1866.	Sept. 1, 1867.	30,650 00	30,650 00	.....	30,650 00	.....	Completed.
88	Section No. 20.	.....	Feb. 7, 1866.	Sept. 1, 1867.	17,050 00	17,050 00	.....	17,050 00	.....	Completed.
89	Section No. 21.	.....	Feb. 7, 1866.	Sept. 1, 1867.	13,130 16	13,130 16	.....	13,130 16	.....	Canceled Oct. 1867.
90	Section No. 22.	.....	Feb. 7, 1866.	Sept. 1, 1867.	13,090 16	13,090 16	.....	13,090 16	.....	Canceled Oct. 1867.
91	Section No. 23.	.....	July 20, 1866.	April 1, 1870.	10,910 80	10,910 80	.....	10,910 80	.....	Completed.
92	Section No. 24.	.....	Feb. 7, 1866.	Sept. 1, 1867.	10,939 86	10,939 86	.....	10,939 86	.....	Completed.
93	Section No. 25.	.....	July 20, 1866.	April 1, 1870.	10,939 86	10,939 86	.....	10,939 86	.....	Completed.
94	Section No. 26.	.....	Feb. 7, 1866.	Sept. 1, 1867.	22,830 00	22,830 00	.....	22,830 00	.....	Canceled Oct. 1867.
95	Section No. 27.	.....	Feb. 7, 1866.	Sept. 1, 1867.	13,430 43	13,430 43	.....	13,430 43	.....	Completed.
96	Section No. 28.	.....	Feb. 7, 1866.	Sept. 1, 1867.	13,430 43	13,430 43	.....	13,430 43	.....	Completed.
97	Section No. 29.	.....	Feb. 7, 1866.	Sept. 1, 1867.	23,700 00	23,700 00	.....	23,700 00	.....	Canceled Oct. 1867.
98	Section No. 30.	.....	Feb. 7, 1866.	Sept. 1, 1867.	38,311 84	38,311 84	.....	38,311 84	.....	Canceled June, 1870.
99	Section No. 31.	.....	July 20, 1866.	April 1, 1870.	46,098 00	46,098 00	.....	46,098 00	.....	Completed.
100	Section No. 32.	.....	Feb. 7, 1866.	Sept. 1, 1867.	10,650 00	10,650 00	.....	10,650 00	.....	Completed.
101	Section No. 33.	.....	Feb. 7, 1866.	Sept. 1, 1867.	40,833 22	40,833 22	.....	40,833 22	.....	Canceled Oct. 1867.
102	Section No. 34.	.....	June 15, 1866.	May 1, 1867.	10,800 00	10,800 00	.....	10,800 00	.....	Completed.
103	Section No. 35.	.....	July 20, 1866.	April 1, 1870.	44,700 00	44,700 00	.....	44,700 00	.....	Completed.

TABLE 2 — (Continued).

Length in chains.	CHARACTER OF WORK.	Appropriation	When let.	When to be completed.	Engineer's estimate.	Estimated cost at contract prices.	Am't done during fiscal year.	Total amount done.	Amount remaining to be done.	Remarks.
79	Section No. 23.	.....	June 15, 1866.	May 1, 1867.	\$45, 100 00	\$76, 271 86	.....	\$76, 271 86	.....	Completed.
80	Section No. 23.	.....	June 15, 1866.	May 1, 1867.	12, 000 00	23, 219 55	.....	23, 219 55	.....	Completed.
79	Section No. 24.	.....	June 25, 1866.	May 1, 1867.	9, 369 20	9, 369 20	.....	9, 369 20	.....	Canceled.
82	Section No. 24.	.....	Nov. 11, 1869.	Nov. 1, 1867.	45, 000 00	30, 972 50	.....	.....	\$30, 972 50	Relet.
82	Section No. 25.	.....	June 15, 1866.	Nov. 1, 1870.	3, 436 79	3, 436 79	.....	3, 436 79	.....	Canceled Oct., 1867.
84	Section No. 25.	.....	Nov. 11, 1869.	May 1, 1867.	22, 000 00	9, 512 00	.....	.....	6, 977 35	Relet.
80	Section No. 26.	.....	June 25, 1866.	Nov. 1, 1870.	108, 455 96	108, 455 96	.....	108, 455 96	.....	Canceled Oct., 1867.
80	Section No. 27.	.....	June 15, 1866.	Nov. 1, 1867.	10, 538 51	10, 538 51	.....	10, 538 51	.....	Canceled Oct., 1867.
85	Sections Nos. 26 and 27.	.....	Sept. 23, 1869.	May 1, 1867.	73, 000 00	64, 403 00	.....	.....	49, 239 52	Relet.
85	Section No. 28.	.....	June 25, 1866.	Nov. 1, 1870.	16, 700 00	16, 520 00	.....	.....	16, 520 00	Old contract.
85	Section No. 29.	.....	June 25, 1866.	May 1, 1867.	10, 910 01	10, 910 01	.....	.....	.....	Canceled Oct., 1867.
87	Section No. 30.	.....	June 15, 1866.	May 1, 1867.	5, 005 28	5, 005 28	.....	.....	.....	Canceled Oct., 1867.
80	Sections Nos. 29 and 30.	.....	Nov. 11, 1869.	Nov. 1, 1870.	24, 000 00	16, 370 00	.....	.....	.....	Relet.
80	Section No. 31.	.....	Feb. 11, 1870.	April 1, 1871.	16, 650 00	10, 060 00	.....	.....	16, 370 00	.....
80	Section No. 32.	.....	Feb. 11, 1870.	April 1, 1871.	17, 200 00	10, 866 00	.....	.....	10, 866 00	.....
80	Section No. 33.	.....	Feb. 11, 1870.	April 1, 1871.	19, 200 00	10, 107 00	.....	.....	10, 107 00	.....
80	Section No. 34.	.....	Feb. 11, 1870.	April 1, 1871.	18, 400 00	10, 605 00	.....	.....	10, 605 00	.....
80	Section No. 35.	.....	Feb. 11, 1870.	April 1, 1871.	23, 600 00	12, 574 00	.....	.....	12, 574 00	.....
80	Section No. 36.	.....	Feb. 11, 1870.	April 1, 1871.	22, 850 00	15, 913 00	.....	.....	15, 913 00	.....
115	Section No. 37.	.....	Feb. 11, 1870.	April 1, 1871.	25, 950 00	15, 353 00	.....	.....	15, 353 00	.....
126	Section No. 38.	.....	Feb. 11, 1870.	April 1, 1871.	80, 725 00	59, 193 00	.....	.....	59, 193 00	.....
.....	Rails, t. pa. on sec. 12, 13, 16, 22, 23.	.....	July 14, 1869.	Nov. 1, 1870.	12, 061 86	12, 061 86	201 86	12, 061 86	.....	Canceled.
.....	Lock No. 1.	.....	June 23, 1865.	Sept. 1, 1866.	1, 933 78	1, 933 78	.....	1, 933 78	.....	Canceled and aband.
.....	Lock No. 2.	.....	June 23, 1865.	Sept. 1, 1866.	2, 376 90	2, 376 90	.....	2, 376 90	.....	Canceled.
.....	Lock No. 3.	.....	June 23, 1865.	Sept. 1, 1866.	1, 772 50	1, 772 50	.....	1, 772 50	.....	Canceled.
.....	Locks Nos. 1 and 3.	.....	Nov. 11, 1869.	Nov. 1, 1870.	81, 730 00	35, 694 00	.....	2, 893 84	34, 870 60	Relet.
.....	Lock No. 4.	.....	Feb. 7, 1866.	Sept. 1, 1867.	4, 457 34	4, 457 34	2, 253 53	4, 457 34	6, 231 43	Canceled Oct., 1867.
.....	Lock No. 4.	.....	July 14, 1869.	Nov. 1, 1870.	12, 995 00	11, 000 00	.....	6, 718 58	.....	Relet.
.....	Lock No. 5.	.....	Feb. 7, 1866.	Sept. 1, 1867.	13, 879 16	13, 879 16	.....	13, 879 16	.....	Relet.
.....	Lock No. 6.	.....	July 14, 1869.	Nov. 1, 1870.	30, 000 00	23, 879 00	.....	10, 010 85	2, 989 15	Completed.
.....	Locks Nos. 7 and 8.	.....	Sept. 23, 1869.	Nov. 1, 1870.	81, 000 00	38, 879 00	.....	10, 449 19	13, 439 81	.....
.....	Choconut aqueduct.	.....	Feb. 7, 1866.	Sept. 1, 1867.	17, 007 16	17, 007 16	.....	17, 007 16	.....	Canceled Oct., 1867.
.....	Tracy aqueduct.	.....	July 14, 1869.	Nov. 1, 1870.	42, 000 00	41, 700 55	.....	40, 200 55	1, 500 00	Relet.
.....	Apalachin aqueduct.	.....	Feb. 7, 1866.	Sept. 1, 1867.	80, 000 00	38, 918 06	.....	85, 918 06	.....	Completed.
.....	Archibald aqueduct.	.....	Nov. 11, 1869.	Nov. 1, 1870.	15, 000 00	8, 097 00	.....	1, 451 60	1, 500 00	Can. Oct. 1867; rescind.
.....	Culverts on sections 1 to 5.	.....	June 23, 1865.	Sept. 1, 1866.	15, 444 44	9, 444 44	.....	1, 444 44	7, 615 40	Canceled Oct., 1867.

[illegible]

TABLE No. 3.
STATEMENT of Authorized Work upon Miscellaneous Repairs under the supervision of the Engineering Department, for the Fiscal Year ending September 30th, 1871.
 ERIE CANAL.

CHARACTER OF WORK.	How authorized.	Appropriation or engineer's estimate.	Amount done.	Amount paid.	Remarks.
Protecting banks on section 7 by refilling with brush and stone.....	By Commissioner upon change of plan.....	\$5,367 60	\$6,373 80	\$5,367 60	To refill with earth deducted.
Bottoming down east of lock No. 47.....	Act chapter 877, Laws of 1869.....	5,000 00	406 80	406 80	Earth above original bottom deducted.
Removing waste-weir and culvert and building aqueduct at Cowaselon.....	By Commissioner under repair contract.....	3,671 90	6,066 63	3,371 90	Materials furnished by State deducted.
Straightening Chittenango Creek channel.....	By Commissioner under repair contract.....	2,374 40	2,374 40	2,374 40	
Vertical wall between Salina and Warren Street bridges, Syracuse.....	By Commissioner under repair contract.....	6,184 77	7,487 77	6,184 77	Materials furnished by State deducted.
Vertical wall above lock No. 49, Syracuse.....	By Commissioner under repair contract.....	1,413 57	1,413 57	1,413 57	
Iron needle beams in bridges at Canastota and Durhamville.....	By Commissioner upon change of plan.....	2,039 47	2,638 84	2,039 47	Old structure deducted
Iron bridge at Oneida.....	By Canal Commissioner, chap. 877, Laws of 1870.....	1,041 65	1,041 65	1,041 65	
Culvert under bridge embankment, Port Byron.....	By Canal Commissioner through superintendent.....	1,633 46	1,633 46	1,633 46	
			\$29,446 41		
OSWEGO CANAL.					
Iron bridge at Durston's dry dock, Syracuse.....	By Commissioner upon change of plan.....	\$535 90	\$596 00	\$535 90	Old structure deducted.
Iron bridge at Bear street Syracuse.....	By Commissioner upon change of plan.....	3,086 28	3,331 00	3,086 28	Old structure deducted.
Driving piles at Caughdenoy and Schroepel.....	By Commissioner under chap. 767, Laws of 1870.....	4,026 17	4,026 17	4,026 17	
Opening State ditch between Mud lock and Liverpool.....	By Commissioner under chap. 767, Laws of 1870.....	3,750 00	3,750 00	3,750 00	
Repairing and strengthening berme bank at Horse Shoe dam.....	By Commissioner under chap. 767, Laws of 1870.....	11,451 00	11,451 00	11,451 00	
Vertical wall on Syracuse level of Oswego canal.....	By Commissioner under chap. 767, Laws of 1870.....	9,903 59	9,927 59	9,903 59	
Vertical wall near Bradley brook.....	By Commissioner under chap. 767, Laws of 1870.....	3,188 00	3,188 00	3,188 00	
			\$56,269 76		

CHENANGO CANAL.

Bridge abutments at Jackson street, Greene.....	By Canal Commis'r, through superintendent	\$1,471 75	\$1,471 75	\$1,471 75
Moving superstructure from Genesee street	By Canal Commis'r, through superintendent	108 66	108 66	108 66
Iron bridge at Mitchell street, Norwich.....	By Canal Comm'r, authorized by Canal Board Dec. 8, 1870..	2,087 00	2,087 00	2,087 00
			\$23,637 41	

CAYUGA AND SENECA CANAL.

Protecting banks, at Seneca Lake, Geneva.....	By Canal Commissioner, chap. 778, Laws of 1871	\$1,210 18	\$1,210 18	\$1,210 18
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CHEMUNG CANAL.

Repairing dam at Gibson	By Canal Commissioner, as a break	\$64,264 26	\$64,264 26	Old structure deducted.
Removing old bridge superstructure and building new stone abutments at Horseheads.....	By Canal Commissioner, chap. 578, Laws 1870	4,779 00	4,993 00	
Transporting superstructure from Court street, Bing- hamton, and putting up at Horseheads.....	By Canal Commissioner, chap. 578, Laws of 1870	990 66	990 66	
Protecting banks of Mill creek.....	By Canal Commis'r, through superintendent	2,090 00	2,090 00	
Extra dredging below lock No. 1.....	By Canal Commis'r, through superintendent	1,453 50	1,453 50	
			\$73,790 42	

CROOKED LAKE CANAL.

Brush and stone protection to banks.....	By Canal Commissioner, chap. 778, Laws of 1871	\$2,800 00	\$2,800 00	\$2,800 00
Rebuilding locks No. 8, 9, 10, 11, 18, 19.....	By Canal Commis'r, through superintendent	60,651 44	60,651 44	60,651 44
Bottoming down lake level at Penn Yan.....	By Canal Commis'r, through superintendent	1,813 28	1,813 28	1,813 28
Lengthening lake lock at Dresden	By Canal Commissioner, chap. 980, Laws of 1871	2,678 91	2,678 91	2,678 91
			\$67,943 63	

TABLE No. 4.

STATEMENT showing the Work not under Contract, Extension of Chenango Canal.

Character of work.	Engineer's estimates.
Section No. 18	\$16,000
Repairing sections Nos. 8 to 17 and 19 to 23, inclusive...	17,000
Four wooden locks, including guard lock.....	91,573
Wappasena aqueduct.....	25,000
Little Wappasena aqueduct	20,000
Ellis aqueduct.....	25,000
Culverts on sections Nos. 31 to 38, inclusive.....	38,000
Railroad bridges at Binghamton	45,000
Bridges, Binghamton to Owego	47,000
Bridges on sections Nos. 31 to 38, inclusive.....	44,200
Total	<u>\$368,773</u>

SUMMARY—Amount of Work done during the Fiscal Year.

CANAL.	Work under contract.	Work upon miscellaneous repairs.	Totals.
Erie, including Otisco Lake reservoir.....	\$103,153 50	\$29,446 41	\$132,599 91
Oswego	121,548 37	36,259 76	157,808 13
Chenango	118,017 42	8,637 41	121,654 83
Chenango extension.....	105,638 92	.....	105,638 92
Chemung	25,624 59	73,790 42	99,415 01
Crooked Lake .....	.....	67,943 63	67,943 63
Cayuga and Seneca.....	25,611 50	1,210 18	26,821 68
Oneida Lake (enlargement)	21,280 00	.....	21,280 00
Total	<u>\$520,874 30</u>	<u>\$312,287 81</u>	<u>\$738,162 11</u>

WESTERN DIVISION.

ANNUAL REPORT OF DANIEL RICHMOND, DIVISION
ENGINEER WESTERN DIVISION NEW YORK STATE
CANALS, FOR THE FISCAL YEAR ENDING SEPTEMBER
30, 1871.

DIVISION ENGINEER'S OFFICE, WESTERN DIVISION, }
ROCHESTER, September 30th, 1871. }

HON. VAN R. RICHMOND, *State Engineer and Surveyor* :

SIR.—In pursuance of the regulations established for the Engineer Department, I herewith transmit my annual report of the Western Division of the New York State canals, for the fiscal year ending September 30th, 1871 :

LENGTH OF COMPLETED CANALS.

	Miles.
Erie canal from east line of Wayne county to Buffalo	148 $\frac{1}{2}$
Genesee Valley canal from Rochester to Millgrove	113 $\frac{1}{2}$
Dansville branch of Genesee Valley canal	11
Total.....	273

NAVIGABLE FEEDERS.

	Miles.
Genesee River feeder at Rochester	2 $\frac{1}{4}$
“ “ “ “ Oramel	$\frac{3}{4}$
Total	3

The canals on this division are supplied with water from the following sources :

ERIE CANAL.

Lake Erie.
Tonawanda creek at Pendleton.
Oak Orchard creek at Medina.

Genesee Valley canal at Rochester.

Genesee river at Rochester.

GENESEE VALLEY CANAL.

Allen's creek at Scottsville.

Genesee river at Mount Morris.

Canasaraga Creek feeder, two miles north of Dansville.

Mill creek at Dansville.

Wiscoy Creek feeder.

Genesee river at Oramel.

Rockville reservoir near Belfast.

Two branches of Black creek on Summit level.

Oil Creek reservoir on Summit level, two miles north of Cuba.

Champlain and Griffin creeks at Cuba.

Ischua feeder from Ischua creek at south end of Summit.

Oil Creek feeder at foot of lock No. 101.

Haskell creek on extension.

Dodge creek on extension at Portville.

Oswayo creek on extension south of Portville.

Allegany river at head of canal at Millgrove.

ENGINEERING DEPARTMENT.

During the past fiscal year, this division has been under the charge of Daniel Richmond, as Division Engineer, and J. Nelson Tubbs as Resident Engineer. Table No. 1, hereto annexed, is a statement containing the names of engineers temporarily employed on this division for the fiscal year, both on ordinary and extraordinary repairs, together with an exhibit of the time of service, and rate of compensation of each.

Table No. 2, annexed, is an exhibit of the character and condition of the work under contract during the year, and table No. 3 makes a like exhibit of work of a miscellaneous character, done under the supervision of this department.

A considerable portion of the expenses included in table No. 1 were incurred on account of work done in making and revising plans, making measurements and supervising ordinary repairs.

The total amount of work done during the fiscal year on this division, under the supervision of this department, not including ordinary repairs, is as follows:

Erie canal	\$358,969.86
Genesee Valley canal	68,198.27
Total	<u>\$427,168.13</u>
Total amount expended for engineering, on both ordinary and extraordinary repairs	<u><u>\$31,867.66</u></u>

ERIE CANAL.

ORDINARY REPAIRS.

That portion of the Erie canal on this division, known as superintendent's sections Nos. 12 and 13, has been kept in repair during the year by the State, through the agency of superintendents, while sections Nos. 10, 11 and 14 have remained in charge of repair contractors.

The contracts for keeping sections Nos. 10 and 11 in repair will expire on the first day of January next, while section No. 14 will not expire by its terms until a year later.

All of these sections have been kept in very excellent repair during the season, and since the repair of the Ox-bow break, navigation has been more uniform and uninterrupted than for many years previous. To maintain the prestige which a successful season's navigation has given the canals, and to still further invite and merit the confidence of shippers and boatmen, the thorough system of repairs inaugurated should be continued; the deposit in the prism thoroughly cleaned out as fast as practicable, by the use of steam dredges, or other appliances, working through the whole season, at points where navigation is most difficult, thus constantly improving the canal in the most thorough, and yet cheapest manner.

The only detention to navigation, of any magnitude or importance, was the great break through the towing path bank at the Ox-bow, about one mile west from Fairport, which occurred in the evening of the 28th of April, and was repaired, and water let in on the 8th of May. A large number of boats were already loaded, and on their way from Buffalo when the break occurred. It was felt at the time to be a severe blow to navigation, but as things have since developed, I believe that all are satisfied that the delay thus caused has resulted in little or no loss to forwarders or boatmen. I think no one can give the cause of the disaster. The bank at that point, although of considerable height (about thirty-five to forty feet) was

in appearance, and was believed to be one of the best on the canal. Watchmen were employed to patrol it frequently during the day and night, and nothing was discovered indicating danger previous to its destruction. Since the rebuilding of the bank, the outside slope has received a heavy covering of loose stone, and has remained in good condition during the season.

The navigation of each recurring season develops the necessity of important changes and improvements at various points on the canal, and which being in the nature of new work, or radical changes in old places, must be provided for year by year, and constructed as

EXTRAORDINARY REPAIRS.

Of work of this character, the following contracts have been completed and settled during the year: Dredging Ohio basin, extending Black Rock pier, improving and widening canal, and constructing vertical walls between Erie and Commercial streets in Buffalo, raising and recoping Black Rock pier, improving and completing Main and Hamburg Street canal, dredging channel around north end of Erie basin break-water, iron bridge over slip leading to river lock at Tonawanda, removing old warehouse foundation at Black Rock, reconstructing docking along channel leading to Niagara river from ship lock; iron bridges over Ohio basin slip, on Georgia street, Buffalo, at Orangeport, McCarty's, Mabees and Palmyra, wrought-iron swing bridge at Albion, and two iron bridges at Brockville and county line, inserting iron needle beams in bridges at Ferry, Genesee, Prime, Michigan and Washington streets, Buffalo, in two bridges in Clyde, three in Lyons, two in Newark, one in Palmyra, one at Macedon, and one at Port Gibson, also at Comstock, Adams, and Millards streets at Lockport, Hindsburgh and Shelby street, Medina, sidewalks on Fulton street in Buffalo, timber bridge over waste-weir channel near Cartersville, vertical walls at Pendleton, Shelby basin, Eagle Harbor, Reynale's basin, and between third and fourth locks east of Rochester, additional sluice culvert in town of Lockport, stop gate between Deep Hollow culvert and Wide Water ditch to drain lands of Thomas McGuire, improving channel way and discharge culvert of Thomas creek, and constructing and testing steam canal dredge.

The present condition of a large number of other contracts of greater or less importance is fully set forth in Table No. 2.

The work of removing old bench walls between Lyons and Lockville is so far progressed that it is hoped that the work below water

may be fully completed by the opening of navigation next spring. The large amount of work progressing in that locality, for doubling locks and other work, has prevented an earlier completion.

The masonry in new Black Rock guard lock is nearly completed, and there is some work remaining to be done at the head and foot of same to complete the contract.

The masonry of the three locks at Lockville is pretty well advanced toward completion, except a short portion of each wall at the head, which will be finished during the suspension of navigation, and the gates inserted, and the lock brought into use. A large amount of material has been delivered at the several locks, and some of the lock pits have been excavated.

It has been found impossible to procure the large amount of dressed stone required for doubling the locks with the rapidity desired, from the difficulty experienced in procuring a sufficient number of stonecutters, there being a large demand for that class of skilled labor. The stone is principally obtained from quarries at Waterloo and Split Rock. Arrangements have been made which render it probable that all of the locks will be completed and brought into use one year from next spring.

The work of improving and deepening narrow canal in Black Rock harbor is in progress, and will be vigorously forwarded during the coming winter. As yet, no work has been done under the contract for protecting canal against the encroachments of Lake Erie.

Act chapter 348, Laws of 1871, provided for the construction of a swing bridge over the Erie canal on Buffalo street, in the city of Rochester, to be placed on the line of said street, and also for the construction of a bridge over Erie canal to connect Munger and Averill streets in said city. Act chapter 930, Laws of 1871, appropriated \$20,000 for the said work. I am satisfied that the said sum is entirely inadequate for the purpose, and that from the peculiar situation of the canal at that point, that such a modification of the law should be made as will allow the swing bridge to be placed at or nearly at right angles with the canal, so that it may swing either way, and so that it may accommodate the travel on Caledonia avenue, and that bridge be also dispensed with, in which case it is believed the appropriation already made will be sufficient to defray all the expenses to be incurred, except the cost of the land necessary to connect the two streets. Act chapter 930, Laws of 1871, also

provides for constructing a vertical wall on the north side of the Main and Hamburg Street canal, between Louisiana and Hamburg streets, in the city of Buffalo, and appropriates \$10,000 therefor. My estimate of the cost of the work between those points is more than double the amount appropriated, and I deem it inexpedient to involve the State in the expense of constructing expensive coffer-dams and bailing a portion of the work, when about the same expense would coffer-dam and bail the whole of it, if the appropriation made was sufficient to complete. At the same time, the very terms of the act, it is believed, debar the Canal Commissioners from letting the work until a sufficient appropriation is made to complete same in full.

WORK RECOMMENDED TO BE DONE.

Act chapter 767, Laws of 1870, appropriated the sum of \$80,000 for the purpose of improving the narrow canal in Black Rock harbor. The work is now in progress on the general plan of making an independent canal channel of not less than 120 feet width from the Buffalo and Niagara Falls railroad bridge to the Erie mill at Lower Black Rock, a distance of 10,500 feet, by the construction of a crib and earth division bank for that distance between the canal and Harbor. The importance of this work is set forth at length in my report of last year, and also in the report of the Canal Commissioner of the Western Division for same year at pages 200 and 201. The estimated cost of the whole work is \$350,000. There should be appropriated the present winter at least \$125,000, so that the work may progress during the next summer, as it is extremely difficult to dredge and prepare the bottom and to sink and fill the cribs late in season after the weather has become inclement and high winds prevalent.

I respectfully recommend the substitution of three iron pipes of twenty-four-inch bore in place of the timber culvert on the three-mile level east of Brighton. This culvert carries under the canal the drainage of a large extent of country, and consequently has to be of considerable capacity. The present structure is of timber, which will soon decay. It is a diving culvert, and necessarily so much below the surface of the surrounding land that when any accident or leakage occurs it is the occasion of much difficulty, expense and delay to coffer dam to bail and repair it. The culvert is also placed in a material which it is very difficult to make tight, and on several

occasions, since its construction, breaks have occurred around it, causing great inconvenience and detention. The pipes proposed can be placed near the bottom of the canal, and thus rendered accessible, and can, at the same time, be easily made secure. I estimate the expense of this improvement at \$8,000.

The old waste weir on Lock Berlin level has given out, and is entirely destroyed in consequence of its being originally located in low, swampy ground. The material in old structure should be all removed, and a new waste weir constructed about 500 feet distant therefrom, on solid formation near the high grounds on the berm side. I estimate the expense of the work at \$3,500.

The present stone box sewer under the Genesee River feeder, at Rochester, has, for many years, been a source of difficulty. The covering is so near the bottom of the feeder, that high water in the Genesee river bursts through the sewer into the feeder, and when the river subsides leaves a passage from feeder into the river. I recommend that a cast-iron pipe of twenty-four inch bore be substituted for same, at an estimated cost of \$3,000.

I respectfully recommend the construction of vertical walls on both sides of the canal at Lockville, in the short reaches between the locks, at an estimated expense of \$25,000.

The levels between the lower and middle, and middle and upper locks at that place, are short and extremely crooked, and it is important that the whole water way which can be obtained be made available, especially so when the new locks are brought into use, and both locks at same time in operation, as they probably will be next season. I recommend that the berm abutment of Arcadia road bridge at the foot of middle lock at Lockville, be set back about fifteen feet, so that free access may be had into the berm lock. It now sets so far into the channel as to be an obstruction to navigation, when the berm lock shall be brought into use. This work will also involve the erection of a new bridge, which should be of iron, the present superstructure being of wood, and having been erected many years ago, would soon have to be rebuilt under any circumstances; the estimated cost of improvement is \$5,000.

In the construction of the Erie canal at east end of the new aqueduct, in the city of Rochester, the line was located so close along South St. Paul street that the street had to be supported by a high wall for a considerable distance, the grade of the street being over twenty feet above bottom of the canal; a wooden protection railing

has always been maintained by the State, on this wall. The railing is now decayed and must be replaced with new. I respectfully recommend that an iron railing be substituted at an estimated expense of \$1,000.

The cost of doubling the locks on this division was originally estimated by me at \$526,000. By act, chap. 877, Laws of 1869, \$200,000 was appropriated, and by act, chap. 767, Laws of 1870, \$200,000 was also appropriated, leaving still to be provided for the sum of \$126,000, which sum should be appropriated during the present winter.

There should also be appropriated the sum of \$1,000 to pay for work done and still to be done in changing line of canal, and protecting same at high clay bluff west of Rochester.

I estimate that there will be required for changing plans of bridges on this division, from wood to iron, the sum of \$35,000.

There is now a waste weir in the old canal, at the east end of the Rochester aqueduct, which at times is useful, but does not draw the water to canal bottom, as the discharge is intercepted by the mill-race between it and the river; the surface of water in said race is higher than the bottom of the canal. For various reasons not now necessary to enumerate, the Canal Board have authorized the abandonment of the old canal at that point, which necessitates the removal of the present waste weir, and the construction of a new and permanent one through the north wall of the aqueduct, and also the construction of a cement wall across the said old canal.

The Canal Board have by resolution adopted the above described plans for the work, and requested the Legislature to make an appropriation of \$4,700, to pay the cost of the work. This sum should be provided for this winter, as the work must be completed previous to the opening of navigation next spring.

GENESEE VALLEY CANAL.

ORDINARY REPAIRS.

All the repair sections have been under the control of, and the repairs made by superintendents during the year. It has been kept in excellent order, and navigation has been uninterrupted.

The slide bank at Portage has stood well, and no trouble has been experienced at that point, although it has been deemed advisable to do considerable work there, to still further secure the same. The various works which have been in progress for several years, for the

purpose of securing a supply of water for the summit, having been perfected previous to the opening of navigation, the canal has reaped the benefit of this foresight; and although we have had one of the driest seasons ever known in that locality, yet an abundant supply has been obtained from the source above named, to keep up navigation through the whole season, with the single exception of the Dansville side cut. Much credit is due the officers in charge, who have carefully husbanded the water from all sources, as at times during the season almost the whole supply south of Mount Morris has been obtained from the Cuba reservoir.

EXTRAORDINARY REPAIRS.

Since the date of my last report, nearly all the important work embraced under this head has been completed, especially that portion of the work looking to supplying this canal with water. No more work has been done, however, under the contract for deepening the north end of the Summit level; the Legislature having passed a bill for the relief of the contractor, the act containing a provision authorizing the Canal Board to cancel the contract, if they deem it for the best interest of the State to do so.

Several iron bridges have been let and will be constructed previous to the opening of navigation next spring.

WORK RECOMMENDED TO BE DONE.

A considerable portion of the eighth ward of the city of Rochester is debarred from effectual drainage by the Genesee Valley canal, and as a consequence, a large amount of surface drainage goes of necessity into the canal. It is important that a culvert be constructed under said canal at such point as will best furnish outlet sewerage from that ward; the estimated expense is \$2,200.

The Genesee Valley canal is now well supplied with water, except the Dansville side cut, which, during the dry season has a very insufficient supply, and navigation cannot at all times be maintained. I repeat my recommendation of last year, on pages 83 and 84 of the report of the State Engineer and Surveyor, that Loon Lake be used as a reservoir for that purpose; the estimated cost is \$10,000.

Of about forty-five miles of the Genesee Valley canal, there are no maps showing State boundaries, structures, etc., in any of the departments. I earnestly urge the importance that final surveys of the same be made at the earliest moment; the estimated cost is \$3,000.

FINAL SURVEYS.

The balance of the final surveys for the Erie canal from Black Rock to and through the city of Buffalo, were completed last winter, as contemplated, and the maps have mostly been plotted. The amount expended for that purpose during the year, is \$2,057.52. I cannot too earnestly urge the necessity of making a final survey of the remaining forty-five miles of the Genesee Valley canal, of which there are no maps in any of the departments. It is a source of endless annoyance and difficulty to those in charge of the canal, and to adjacent owners, as there is no authoritative source where boundaries between the State and private parties can be obtained ; and the necessity which often arises to furnish maps of portions of the canal for the information of the Legislature, the Canal Board, and Canal Appraisers, involves a special survey at the points required, often producing great inconvenience to parties, and delays vexatious to all concerned.

RECAPITULATION OF APPROPRIATIONS RECOMMENDED TO BE MADE.

ERIE CANAL.

Continuing the work of constructing division bank, and widening, deepening, and otherwise improving the canal in Black Rock Harbor.....	\$125,000
Constructing iron pipe culvert in place of timber, under canal on three mile level, in Brighton.....	8,000
Constructing new waste weir on Lock Berlin level, in lieu of one destroyed.....	3,500
Iron pipe sewer in place of box sewer, under Genesee River feeder, near Rochester.....	3,000
Vertical walls on both sides of canal at Lockville, in the short reaches between the locks.....	25,000
Setting back berme abutments of, and constructing iron in place of wood bridge at Lockville.....	5,000
Iron protection railing on high wall between South St. Paul street and canal, in the city of Rochester.....	1,000
Completing the doubling the locks on Western Division.	126,000
To pay for work done and still to be done in changing line of canal, and protecting same at high clay bluff west of Rochester.....	1,000
For changing plans of bridges on Western Division.....	35,000
Constructing a waste weir through north wall of aqueduct at Rochester, and cement wall across old canal at east end of said aqueduct.....	4,700

GENESEE VALLEY CANAL.

Iron pipe culvert under canal in city of Rochester.....	2,200
Making outlet for Loon lake, and so discharge the waters as to make them available as a feeder for the Dansville side cut canal.....	10,000
Final survey and maps for that part of canal for which there are no maps on file.....	3,000

Respectfully submitted.

DANIEL RICHMOND,

Division Engineer, Western Division.

TABLE No. 1.

STATEMENT showing Name, Number of Days and Compensation of Engineers upon the Repairs of the Western Division of the New York State Canals, together with Incidental Expenses during the Fiscal Year ending September 30th, 1871, under act, chap. 169, Laws of 1863.

ERIE CANAL—REPAIRS.

NAMES.	Nature of service.	No. of days.	Rate of compensa- tion.	Amount.	Total.
Daniel Richmond	Division engineer	Salary ..	\$2,400 00	\$1,600 00	\$3,579 22
Daniel Richmond	Division engineer	Travel ..	6c. per m.	425 70	
J. Nelson Tubbs	Resident engineer	Salary ..	2,000 00	1,333 32	
J. Nelson Tubbs	Resident engineer	Travel ..	6c. per m.	220 20	
<i>Incidental Expenses.</i>					
Stationery				\$271 95	1,489 37
Fuel, light and office rent.....				622 78	
Postage and telegraph				178 14	
Miscellaneous				416 50	
Total for Erie canal.....					\$5,068 59

GENESEE VALLEY CANAL—REPAIRS.

Daniel Richmond	Division engineer	Salary ..	\$2,400 00	\$800 00	\$2,087 82
Daniel Richmond	Division engineer	Travel ..	6c. per m.	410 58	
J. Nelson Tubbs	Resident engineer	Salary ..	2,000 00	666 68	
J. Nelson Tubbs	Resident engineer	Travel ..	6c. per m.	160 56	
<i>Incidental Expenses.</i>					
Stationery				\$122 76	693 25
Fuel, light and office rent.....				224 25	
Postage and telegraph				97 02	
Miscellaneous				179 22	
Total for Genesee Valley canal					\$2,731 07

RECAPITULATION.

Erie canal.....	\$5,068 59
Genesee Valley canal	2,731 07
Total.....	\$7,799 66

TABLE No. 1 — (Continued).

STATEMENT showing the Assistants temporarily employed on Ordinary Repairs during the Fiscal Year ending September 30th, 1871, and paid by the Canal Commissioner.

ERIE CANAL — ORDINARY REPAIRS.

NAMES.	Nature of service.	No. of days.	Rate of compensation.	Amount.	Total.
L. L. Nichols (watersur.)	Assistant engineer.	51	\$6 00	\$306 00	
George Arnolds	Assistant engineer.	39	6 00	234 00	
J. Fred. Behn	Assistant engineer.	21	5 50	115 50	
Thos. Evershed	Assistant engineer.	6	5 50	33 00	
John Blagood	Draughtsman	18	5 50	99 00	
A. W. Barrett	Leveller	15	4 00	60 00	
N. E. Storey	Rodman	5	4 00	20 00	
R. B. McFarlin	Chainman	58	3 25	172 25	
Edward Bally	Axeman	16	2 00	32 00	
M. N. Hutchinson	Axeman	6	2 00	12 00	
S. H. Oviatt	Inspector	5½ mos.	60 00	320 00	
					\$1,403 75

GENESEE VALLEY CANAL — ORDINARY REPAIRS.

H. V. B. Barker	Assistant engineer.	127	\$5 50	\$698 50	
George Arnolds	Assistant engineer.	27	6 00	162 00	
Byron Holley	Assistant engineer.	24	5 50	131 00	
					\$991 50

RECAPITULATION.

Erie canal		\$1,403 75
Genesee Valley canal		991 50
Total		\$2,395 25

TABLE No. 1 — (Continued).

STATEMENT showing the Assistants temporarily employed on Extraordinary Repairs during the Fiscal Year ending September 30th, 1871, and paid by Canal Commissioner.

ERIE CANAL — EXTRAORDINARY REPAIRS.

NAMES.	Nature of service.	No. of days.	Rate of compensation.	Amount.	Total.
J. Fred. Behn	Assistant engineer	295	\$5 50	\$1,622 50	
Byron Holley	Assistant engineer	252	5 50	1,386 00	
George Arnolds	Assistant engineer	213	6 00	1,278 00	
F. F. Curry	Assistant engineer	187	5 50	753 50	
Thomas Evershed	Assistant engineer	26	5 50	143 00	
John Bisgood	Draughtsman	232	5 50	1,276 00	
R. V. Arnolds	Draughtsman	216	3 50	816 50	
L. Gardner	Leveler and surveyor	133	5 00	665 00	
A. W. Barrett	Leveler	230	4 00	920 00	
N. E. Storey	Rodman	90	3 50	315 00	
R. B. McFarlin	Rodman	153	3 25	497 25	
John Spaulding	Rodman	20	3 00	60 00	
E. A. Judd	Chainman	313	3 00	939 00	
Byron Holley, Jr.	Tapeman	24	2 50	60 00	
Edward Rigney	Axeman	10	2 00	20 00	
L. H. Spencer	Inspector	236	5 00	1,180 00	
John Hausle	Inspector	313	4 00	1,252 00	
R. S. Patterson	Inspector	112	3 50	391 50	
M. Schuster	Inspector	23	3 50	77 00	
A. H. Towar	Inspector	139	3 00	417 00	
J. H. Boulton	Inspector	90	3 00	270 00	
George Talbot	Inspector	77	3 00	231 00	
Alexander Gray	Inspector	24	3 00	72 00	
Jesse Bumpus	Inspector	93	2 50	232 00	
W. H. Cornes	Inspector	52	3 50	182 00	
Augustus Davis	Inspector	34	2 50	85 00	
Alanzo Reid	Inspector	29	2 50	72 50	
P. R. Terry	Inspector	53	2 50	132 00	
J. B. Ransom	Inspector	49	3 00	147 00	
Edmund O'Grady	Inspector	3 m. 8 da.	60 00	136 00	
S. H. Oviatt	Inspector	½ mo.	60 00	40 00	
					\$15,614 75

TABLE No. 1—(Continued).

STATEMENT showing the Assistants temporarily employed on Extraordinary Repairs during the Fiscal Year ending September 30th, 1871, and paid by Canal Commissioner.

GENESEE VALLEY CANAL—EXTRAORDINARY REPAIRS.

NAMES.	Nature of service.	No. of days.	Rate of compensation.	Amount.	Total.
H. V. B. Barker	Assistant engineer	228	\$5 50	\$1,319 00	
Byron Holley	Assistant engineer	66	5 50	363 00	
George Arnolds	Assistant engineer	86	6 00	516 00	
F. F. Curry	Assistant engineer	34	5 50	187 00	
John Blsgood	Draughtsman	63	5 50	346 80	
R. V. Arnolds	Draughtsman	97	3 50	337 50	
L. Gardner	Leveler and surveyor	180	5 00	900 00	
N. F. Comstock	Leveler	16	5 00	50 00	
A. W. Barrett	Leveler	86	4 00	372 00	
R. B. McFarlin	Rodman	54	3 25	175 00	
N. E. Storey	Rodman	24	3 25	78 00	
J. Spaulding	Rodman	40	3 00	120 00	
G. G. Russell	Chainman	79	3 00	237 00	
Edward Rigney	Axeman	72	2 00	144 00	
H. V. B. Barker, Jr.	Axeman	87	2 00	174 00	
Alexander Gray	Inspector	56	3 00	168 00	
M. W. Cole	Inspector	86	2 70	236 00	
W. Sickles	Inspector	50	2 50	125 00	
S. H. Oviatt	Inspector	5 mos.	60 00	300 00	
					\$6,068 00

RECAPITULATION.

Erie canal	\$15,614 75
Genesee Valley canal	6,068 00
Total	\$21,672 75

SUMMARY OF TABLE No. 1,

Showing Engineering Expenses for Fiscal Year ending September 30th, 1871.

NAME OF CANAL.	Engineer's proper.	Incidental expenses.	Amount.	Total.
Repairs proper, Erie canal	\$3,579 22	\$1,489 87	\$5,068 59	
Repairs proper, Genesee Valley canal	2,087 82	698 25	2,731 07	
Repairs ordinary, Erie canal	1,408 75	.....	\$1,408 75	
Repairs ordinary, Genesee Valley canal	991 50	.....	991 50	
Repairs extraordinary, Erie canal	15,614 75	.....	\$15,614 75	
Repairs extraordinary, Genesee Valley canal	6,068 00	.....	6,068 00	
				21,672 75
Total				\$31,867 66

TABLE No. 2.

STATEMENT showing Character of Work, Estimated Cost at Engineer's and Contract Prices, the amount done during the Fiscal Year ending September 30th, 1871, and the amount remaining to be done on work under contract on the Western Division.

ERIE CANAL.

CHARACTER OF WORK.	Engineer's estimate with engineering and contingencies added.	Estimated cost at contract prices.	Amount done during fiscal year.	Total amount done.	Amount remaining to be done.
Dredging Ohio basin	\$18,000 00	\$17,979 53	\$339 53	\$17,979 53	Settled.
Extending Black Rock pier	10,000 00	8,800 00	3,000 00	8,800 00	Settled.
Deepening and improving narrow canal in Black Rock harbor	78,000 00	78,000 00	3,600 00	8,600 00	\$74,400 00
Improving and widening canal and constructing vertical wall between Erie and Commercial streets, Buffalo	30,000 00	28,896 35	28,896 35	28,896 35	Settled.
Protecting canal against encroachments of Lake Erie	75,000 00	75,000 00	.....	.....	75,000 00
Raising and re-coping Black Rock pier	10,000 00	9,480 34	780 34	9,480 34	Settled.
Extending, raising and strengthening division bank at Lower Black Rock	5,000 00	5,000 00	1,700 00	1,700 00	8,300 00
Improving and completing Main and Hamburg Street canal	15,000 00	13,822 80	2,818 52	13,822 80	Settled.
Dredging channel around north end Erie Basin breakwater	17,500 00	16,881 99	2,741 99	16,881 99	Settled.
Removing deposit from Black Rock harbor	30,000 00	30,000 00	11,900 00	21,460 00	8,540 00
Removing abutments and superstructure of old bridge and constructing new iron bridge over slip leading to river lock, Tonawanda	5,800 00	5,658 98	5,658 98	5,658 98	Settled.
Orb work and vertical wall on guard lock section and clearing out mill-race at Black Rock	30,000 00	30,000 00	.....	.....	30,000 00
Removing old warehouse foundation at Black Rock	3,200 00	2,807 43	167 43	2,807 43	Settled.
Doubling guard lock at Black Rock	47,000 00	47,000 00	23,400 00	23,600 00	17,400 00
Reconstructing docking along channel leading to Niagara river below Ship lock at Black Rock	600 00	589 95	589 95	589 95	Settled.
Constructing guard piers and protecting and securing swing bridge at Ferry street in Black Rock harbor	5,000 00	5,000 00	1,600 00	1,600 00	3,400 00
Constructing pipe sewer along Erie canal to State ditch, Tonawanda	3,500 00	3,500 00	1,200 00	1,200 00	2,300 00
Iron bridge over Ohio basin slip on Fulton street, Buffalo	6,500 00	5,829 14	5,829 14	5,829 14	Settled.
Iron bridge on Georgia street, Buffalo	12,000 00	11,968 83	2,828 83	11,968 83	Settled.
Inserting iron needle beams in bridge on Ferry, Genesee, Prime and Michigan streets, Buffalo	10,000 00	9,515 40	9,515 40	9,515 40	Settled.
Inserting iron needle beams in bridges on Washington street, Main and Hamburg streets canal	2,000 00	1,999 53	1,999 53	1,999 53	Settled.
Side-walks on Fulton street bridge in Buffalo	500 00	499 74	499 74	499 74	Settled.
Inserting iron needle beams in two bridges at Clyde, three at Lyons and two at Newark	6,800 00	4,581 52	361 52	4,581 52	Settled.
Inserting iron needle beams in bridges at Palmyra, Macedon and Port Gibson	2,300 00	2,068 55	2,068 55	2,068 55	Settled.

TABLE No. 2 — (Continued).

CHARACTER OF WORK.	Engineer's estimate with engineering and contingencies added.	Estimated cost at contract prices.	Amount done during fiscal year.	Total amount done.	Amount remaining to be done.
Inserting iron needle beams in bridge at Comstock's, Adams', Millard's, Hindburgh and Shelby street.	\$8,000 00	\$6,492 42	\$3,293 42	\$6,492 42	Settled. \$2,800 00
Inserting iron needle beams in bridges at Eagle Harbor and Young's.	2,800 00	2,800 00	3,071 66	3,071 66	Settled.
Iron bridge at Orangeport.	2,800 00	2,216 36	2,216 36	2,216 36	Settled.
Iron bridge at McCabe's.	2,800 00	2,639 66	2,639 66	2,639 66	Settled.
Wrought iron swing bridge at Albion and two iron bridges at Brockville and County Line.	16,500 00	15,071 26	15,071 26	15,071 26	Settled.
Removing easterly bridge at Palmym and constructing additional roadway to bridge on Main street.	10,000 00	9,737 14	1,737 14	9,737 14	Settled.
Timber bridge over waste-weir channel near Carletonville.	1,085 25	1,085 25	255 29	1,085 29	Settled.
Iron bridge on town line between Greece and Gates.	9,700 00	7,500 00	.....	.....	7,500 00
Iron bridge on Smith street, city of Rochester.	4,100 00	4,100 00	.....	.....	4,100 00
Iron bridge on section No. 275.	6,500 00	6,500 00	.....	.....	6,500 00
Iron towpath bridge over Genesee Valley canal at junction with Erie canal.	3,000 00	3,400 00	.....	.....	3,400 00
Vertical wall at Pendleton.	3,500 00	3,307 40	3,307 40	3,307 40	Settled.
Vertical wall near Shelby Basin.	3,000 00	2,773 25	2,773 25	2,773 25	Settled.
Vertical and slope wall at Eagle Harbor.	4,000 00	2,112 83	2,112 83	2,112 83	Settled.
Vertical wall at Reynolds's Basin.	2,000 00	1,056 34	1,056 34	1,056 34	Settled.
Vertical wall between third and fourth locks east of Rochester.	2,000 00	1,419 89	1,419 89	1,419 89	Settled.
Vertical wall at Bushnell's Basin and Cartersville.	3,000 00	3,000 00	.....	.....	3,000 00
Vertical wall at Fairport.	1,000 00	1,000 00	.....	.....	1,000 00
Vertical wall and bridge across State ditch at Macedon.	5,400 00	5,400 00	.....	.....	5,400 00
Removing bench walls and constructing slope wall and pavement between Lyons and Lockville.	60,000 00	60,000 00	24,300 00	24,300 00	35,700 00
Raising and improving Sulphur Spring guard lock.	11,000 00	.....	.....	.....	Abandoned.
Doubling Clyde lock.	34,000 00	33,000 00	10,140 00	11,000 00	23,000 00
Doubling Lock Berlin lock.	37,000 00	36,000 00	8,680 00	14,800 00	21,200 00
Doubling Lyons lock.	35,000 00	34,000 00	5,940 00	8,800 00	25,200 00
Doubling Foot-house lock.	35,000 00	35,000 00	15,300 00	17,000 00	21,000 00
Doubling lower lock at Lockville.	35,000 00	35,500 00	16,300 00	34,800 00	8,600 00
Doubling middle lock at Lockville.	36,000 00	34,500 00	13,940 00	24,800 00	10,200 00
Doubling upper lock at Lockville.	37,000 00	35,000 00	11,100 00	26,300 00	8,700 00
Doubling lower Macedon lock.	40,000 00	38,000 00	7,340 00	9,060 00	28,940 00
Doubling Pittsford lock.	34,000 00	33,000 00	4,400 00	5,800 00	27,200 00
Doubling Miller's lock.	35,000 00	34,000 00	480 00	4,400 00	29,600 00
Doubling lock No. 3 east of Rochester.	36,000 00	37,500 00	5,180 00	5,180 00	30,820 00
Doubling lock No. 2 east of Rochester.	39,000 00	37,500 00	5,000 00	5,180 00	33,320 00
Doubling lock No. 1 east of Rochester.	38,000 00	37,500 00	6,830 00	10,120 00	27,880 00
Receiver for White's creek near Wayneport.	3,000 00	3,800 00	2,060 00	2,060 00	1,740 00

GENESEE VALLEY CANAL.		
Slide bank at Portage	\$79,000 00	\$78,967 90
Raising Oil Creek reservoir	187,800 00	180,317 45
Deepening Summit level from lock No. 97 to entrance of feeder from Oil Creek reservoir	9,000 00	8,000 00
Iron bridge over Creek feeder at Cuba	5,613 45	5,613 45
Iron bridge on State street at Olean	3,500 00	3,273 55
Iron bridge near Blood's farm near Portage	1,800 00	1,531 33
Iron bridge on Adams street, Rochester	2,400 00	1,436 36
Iron bridge on Atkinson street, Rochester	2,400 00	1,831 87
Iron bridge at Cummingsville	2,300 00	2,000 00
Iron bridge at Fillmore	2,300 00	2,300 00
Iron bridge at Hinsdale	3,500 00	3,500 00
Iron bridge at Canawagus	2,000 00	2,000 00
Re-building guard bank in town of Hume	4,000 00	2,340 56
Completing the widening, deepening and improving Genesee Valley canal at Rochester	88,786 50	88,786 50
Clearing out channel of Baird's creek below aqueduct	7,000 00	6,080 00
Stone abutments and docking at east end of Genesee River dam at Mount Mor-	13,000 00	13,000 00
ris	.....	.....
	\$320,534 85	\$306,660 00

GENESEE VALLEY CANAL.		
Slide bank at Portage	\$79,000 00	\$78,967 90
Raising Oil Creek reservoir	187,800 00	180,317 45
Deepening Summit level from lock No. 97 to entrance of feeder from Oil Creek reservoir	9,000 00	8,000 00
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Iron bridge at Cummingsville	2,300 00	2,000 00
Iron bridge at Fillmore	2,300 00	2,300 00
Iron bridge at Hinsdale	3,500 00	3,500 00
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Re-building guard bank in town of Hume	4,000 00	2,340 56
Completing the widening, deepening and improving Genesee Valley canal at Rochester	88,786 50	88,786 50
Clearing out channel of Baird's creek below aqueduct	7,000 00	6,080 00
Stone abutments and docking at east end of Genesee River dam at Mount Mor-	13,000 00	13,000 00
ris
	\$320,534 85	\$306,660 00

TABLE No. 3.

STATEMENT showing Amount of Work done under the supervision of the Engineer Department, on Miscellaneous Repairs authorized by the Canal Board and Canal Commissioners, and amount paid thereon during the Fiscal Year ending September 30th, 1871.

DESCRIPTION OF WORK.	Amount appropriated.	Total amount done.	Amount paid during year.
Repairing damages caused by gales and high water of Lake Erie	\$40,000 00	\$40,000 00	\$25,000 00
Protecting and securing towing-path b'k of Erie canal, Oxbow	8,626 58	8,626 58	8,626 58
Rebuilding bridge over State ditch near Tonawanda.....	2,784 73	2,784 72	2,784 73
Clearing out State ditch at Tonawanda	1,008 70	1,008 70	1,008 70
Repairing Hodginsville sluice culvert.....	1,915 87	1,200 00	1,020 00
.....	\$58,435 01

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